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Authors' Index

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Hydraulic Dam Construction in Marin County, California

Wyatt H. Allen.

In a paper entitled "Recent Practice in Hydraulic-Fill Dam Construction," very lately presented before the American Society of Civil Engineers, by Mr. James D. Schuyler, the author clearly demonstrates that, while the requirements involved in the design of any earth-fill dam may be fulfilled by the usual methods of moistening, rolling and tamping, due care being exercised in construction and selection of materials, the system known as the hydraulic fill is cheaper and more efficient.

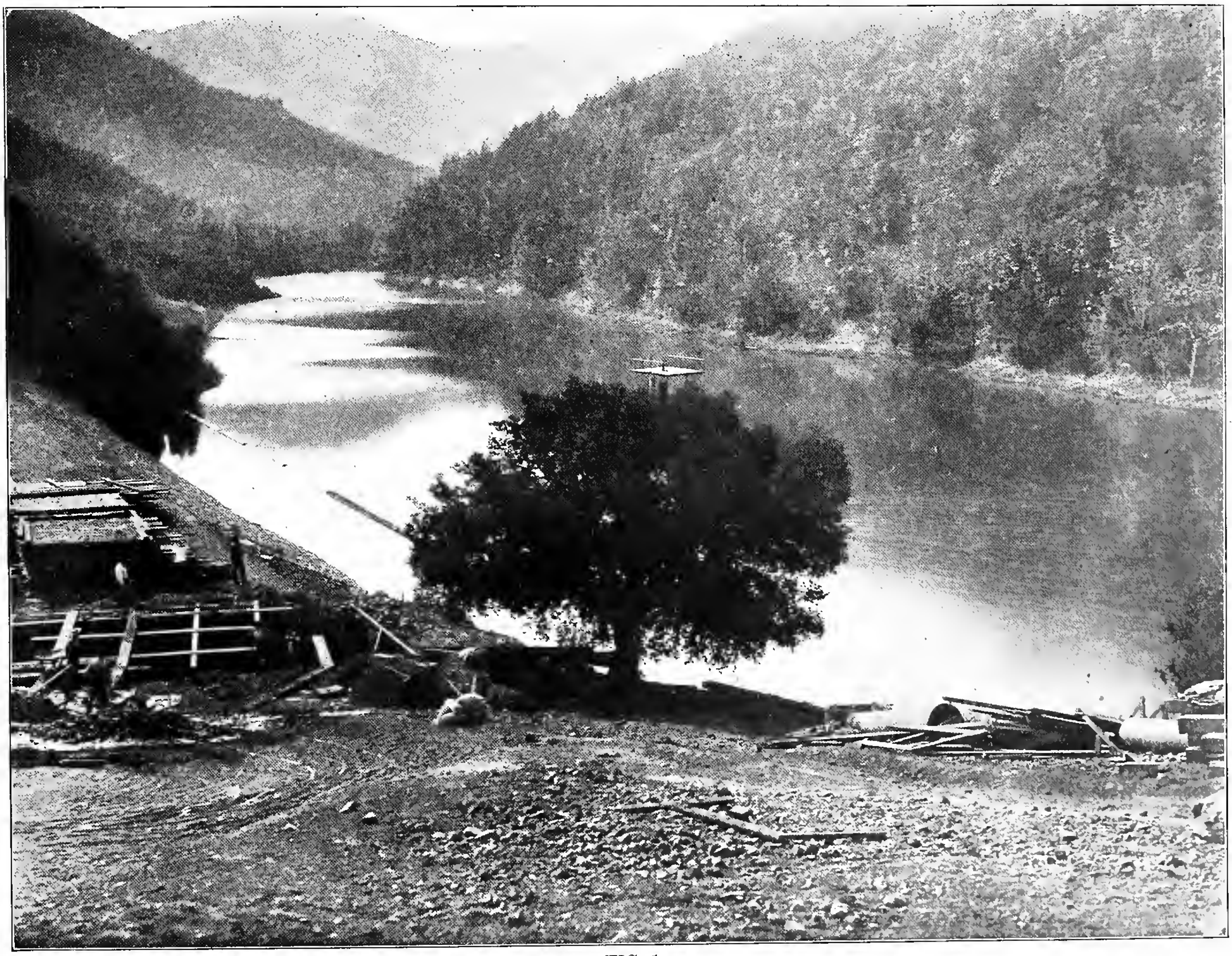

FIG. 1.
VIEW OF EAST END OF LAKE LAGUNITAS, LOOKING UP BILL WILLIAMS GULCH.

That it is not always practicable to employ this method of construction may be readily realized upon consideration of the natural advantages necessary thereto, primarily, proper materials, natural fall or head to produce pressure and water in sufficient quantity for excavating and depositing material.

The Phoenix Gulch Dam of the Marin County Water Company was constructed by the hydraulic method in so far as the deposit of material in the fill was concerned, but owing to the lack of a sufficient quantity of water under pressure, only a small proportion of the excavation was accomplished by this means.

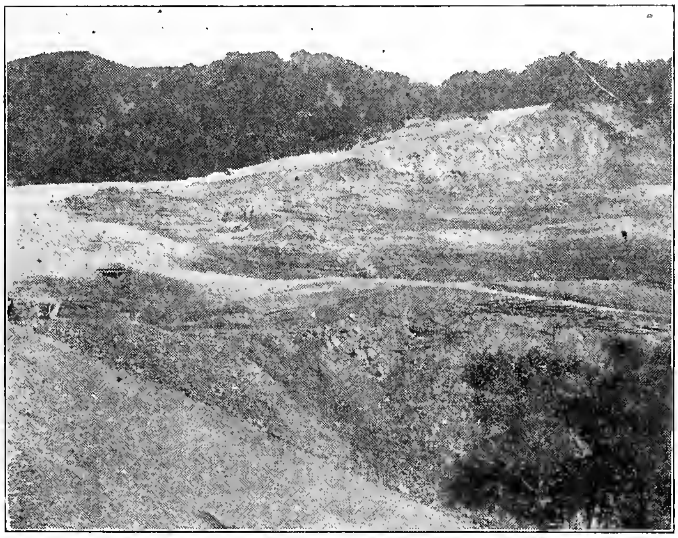

FIG. 2.
VIEW OF BORROW PITS AT WEST END OF DAM.

For many years the company has supplied water to San Rafael and the adjacent country in Marin County, the supply being derived from Lake Lagunitas, which lies on the northeasterly slope of Mt. Tamalpais, at an elevation of a little more than 700 feet above sea level. The lake is fed by springs and the run-off of rainfall over the adjacent water shed. The water of Lagunitas is favorably known for softness and purity.

With the rapid increase of suburban population during recent years the inadequacy of the water supply was only too apparent, and to meet this condition plans for an auxiliary reservoir were formulated. The final choice of the location is at the confluence of Phoenix and Bill Williams' gulches, approximately one and one-half miles west of Ross Station, on the North Shore Railroad, and at an elevation of 100 feet above sea level.

The incidents and considerations leading to the selection of this site, while interesting in that they serve to show the short sight of some individuals connected with county affairs and the discouraging attitude of a minority toward corporations engaged in progressive development, are not for discussion here.

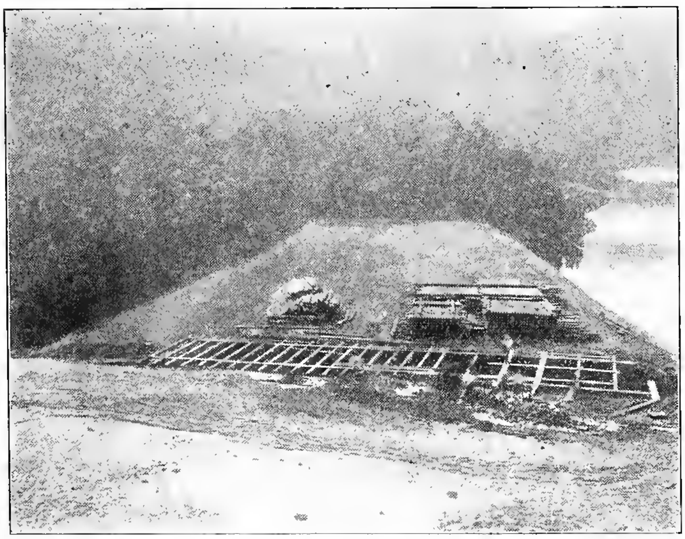

FIG. 4.
VIEW OF DAM LOOKING EAST, SHOWING SPILLWAY UNDER CONSTRUCTION.

The dam is designed for an ultimate height of 90 feet to be carried up only 75 feet until such time as it becomes necessary to increase the storage. The slopes are 2 to 1 on the back slope and 2½ to 1 on the water face. The length of crest for the 75-foot height is 285 feet, and the transverse width of crest is 20 feet for the height of 90 feet.

For a width of 20 feet up and down stream along the longitudinal axis of the dam, the surface of the ground was removed down to bed rock, thoroughly cleaned and all crevices cemented. During the construction the best material was selected and placed in the cut forming a key and core wall 20 feet in thickness and of material impervious to water. The top soil was entirely removed from the site of the dam and the entire area of the reservoir cleared of brush, trees, etc.

The location of the borrow pits, as will be seen in Fig. 2, is just above the dam on the north hillside. The material consists of layers of stiff, blue clay overlaid by clayey brown earth interspersed with boulders and small rock. The selection of material from the pits consisted in placing the clayey earth and small rock on the back face or wall of the dam, while the pure clay was distributed over the center core and water face.

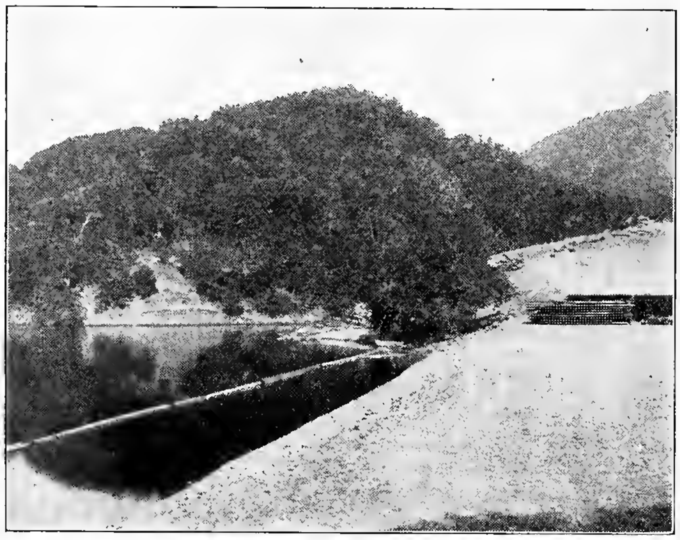

FIG. 5.
WEST END OF DAM, SHOWING END OF TRAMWAY ABOVE WATER.

Sluice boxes were constructed on trestles running down the hillside from the borrow pits, heading fairly close together and spreading widely apart toward the bottom of the dam site. The boxes were made in sections 12 feet in length and 1 foot wide by 2 feet deep. Each section was provided with iron hooks to clamp to the section following, and the supporting bents were made sufficiently wide to allow of the boxes being shifted sideways 8 to 12 feet.

Near the head of each sluice box was a driveway with an opening and chute leading into the box, allowing material moved by scrapers to be dumped into it. A stream of water under pressure issuing from a nozzle placed just below the trap, served to break up the mass and carry it into place at the end of the sluice box.

As the overhanging banks of the borrow pits were blasted out and scraped to the sluices it became possible to use streams of water directed against the banks to undermine and wash the material directly into the boxes.

The supply of water was obtained by tapping the Marin County Water Co.'s main pipe line leading from Lagunitas to the subsidiary reservoirs in San Rafael. Three 3-inch

taps were taken off, but on account of the size of the main pipe it was not always possible to use more than two of the outlets without decreasing the town supply and lowering the water in the subsidiary reservoirs.

The streams from the hose nozzles were effective against the looser material found in the borrow pits, but made no impression on the blue clay. It was necessary to blast this and then break up the loosened mass by means of the water. All rock was laid aside to be later used in rip-rapp on the water face of the dam.

The work of placing material in the fill was not commenced until late in January, 1906, owing to a shortage of water due to extremely late rains. All grubbing and clearing had been previously completed and the work was carried on during wet and dry weather almost continuously to its completion in June.

During the heaviest storms it became impossible to work teams in the clay, but to offset time lost in this way a considerable amount of night work was done by the light of gasoline torches.

By the time the fill was well started a steam pump and boiler were installed by the contractor for pumping water from the gulch for use at the borrow pits. Sufficient clear water was by this time flowing down the creeks to enable the pump to add very materially to the pressure water supply, and the amount of material moved per 24 hours was correspondingly increased, reaching at times over 1,200 cubic yards. The total fill is slightly in excess of 73,000 cubic yards.

The scour outlet from the reservoir consists of a 30-inch extra heavy cast-iron pipe laid in concrete beneath the dam. At the inner end a 90-degree elbow turns vertically upward, the mouth being provided with a bronze seat for a stand pipe or "bottle" valve fitting snugly against the bevelled surface of the bronze.

The standpipe portion of the valve is supported from a steel tower, Fig. 5, by means of a stem with screw and nut attached to its upper end. Guides are provided to seat the standpipe accurately into the lower half of the valve, and a ratchet lever fitting the nut is operated from a platform at the top of the tower to raise or lower the stand pipe.

With the reservoir full a rise of four inches of the upper portion of the valve or stand pipe is sufficient to discharge all the water the creek below the dam is capable of carrying, without overflowing its banks.

The valve and tower were designed by Mr. Wynn Meredith, now of the engineering firm of Hunt, Dillman, Meredith & Allen, Inc. The tower legs are built up of 4-inch screw pipe with screw flanges bolted together every ten feet. The legs rest upon concrete piers to which are bolted special angle flanges inclined from the vertical to allow for the batter of the tower legs. The lateral bracing is made up of light angle iron and the diagonal bracing of round iron with turnbuckles. Plates with lugs forming a bolted joint with the bracing are inserted between the flanges at the joints of the legs.

The bottom of the spillway is 6 feet below the crest of the dam. The spillway is 16 feet in width and 6 feet in depth, tapering as the grade increases to 10 feet in width.

FIG. 3.
VIEW OF SOUTH END OF LAKE LAGUNITAS, LOOKING UP PHOENIX GULCH, SHOWING TOP OF VALVE TOWER.

It is constructed of redwood throughout and carries spill water well below the down-stream toe of the dam.

On the back face of the dam beams are provided at elevations of 30 feet and 60 feet above the down-stream toe. The beams are 5 feet in width and slope inward toward the dam, draining into paved gutters for leading rain water off the face.

Water from the reservoir is pumped into a small basin on the hillside above, and is piped thence into the main pipe line leading to San Rafael and other points. A tramway consisting of heavy timbers bolted to concrete piers leads down into the water from an elevation slightly above the crest of the dam. Rails are laid on the timbers and a car containing the pumping plant is lowered or raised along the rails by means of a hand winch at the top of the tramway, thus keeping within the suction limit of the pump as the water recedes.

The pumping plant consists of a triple-cylinder marine gas engine directly connected to a triplex pump, the whole being mounted on the car, together with a gasoline supply tank, etc. The plant has a normal capacity of 500,000 gallons per 24 hours and is arranged to be speeded up to reach a capacity of 800,000 gallons when necessary. The maximum lift required is 200 feet.

The fill was contracted for at a definite price per cubic yard of material placed in the fill, the grubbing and clearing at a price per acre, the stripping of the top soil from the dam site and borrow pits per cubic yard in place, and the remainder of the work was done on the force account plus a percentage. The company furnished all materials, such as pipe, cement, rock, etc., and a definite agreement was made as to daily wage of labor of different classes and the cost of teams.

The drainage area tributary to reservoir is approximately six square miles. The surface area of the reservoir when full is 16 1-3 acres and its capacity 118 million gallons. If the dam is raised to a height of 90 feet a storage of 220 million gallons is obtainable.

The method of placing material in the fill with water, insured an absolute compactness and tightness in the junction with the material already in place. The quality of material used could hardly be better, though this very quality made it extremely difficult to handle. Lumps and sticky masses of clay frequently clogged the sluices and necessitated constant watchfulness. The center portion of the dam was kept concave during construction, thus insuring the flow of the finer material to this portion.

The rip-rapp on the water face was laid by hand to line, and later a boom of logs chained together was stretched across the water in front of the dam to break the wave action. The work was completed and the reservoir filled in June of 1906.

LIFE OF WOODEN POLES.

The German Postal and Telegraph Department has recently published statistics collected during a period of 52 years on the life of wooden posts impregnated with different preservative substances. The number of posts under observation amounts to nearly 3,000,000, and the following are the average results obtained:

Poles Impregnated with	Length of Life.
Sulphate of Copper	11.7 years
Corrosive Sublimate	13.7 years
Creosote	20.6 years
Unimpregnated	7.7 years

The manner of preparing the poles has been improved from time to time, and this is clearly shown in a further table giving the average length of life of the poles under different methods of treatment with each preservative at different periods. For example, in 1883, with sulphate of copper the average life was 9.4 years, while in 1903 the method of treatment had been improved so that an average life of 13.3 years could be obtained.—"Electrical Magazine."

THE DEVELOPMENT OF THE GAS ENGINE.*

By Dugald Clerk, M. Inst. C. E., F. C. S.

It has been my fate to be associated with the development of the internal combustion motor for the past thirty years. My attention was first drawn to the gas engine, as it was then called, at the end of 1876. At that date the only types of engine in operation were the non-compression engines of Lenoir and the non-compression free piston engine of Otto and Langen. In 1876 the Lenoir engine had practically disappeared from the market, and the only commercial engine then in use was the Otto and Langen. This was a very cumbersome engine, operated with great noise and much recoil, and the largest of the type in use in the world did not exceed 3 horsepower. In that year the user of motive power had but little choice. He was practically confined to the steam engine, both for small and large powers. The motive power user to-day is in a more fortunate position. Many types of engines and motors compete for his favor.

These thirty years have seen a marvelous development of the gas engine, and an extension of the use of different fuels which has caused the old title "gas engine" to disappear, and the comparatively new title, "internal combustion motor," to come into use.

The gas engine originated, as its title clearly shows, in a form of engine adapted to use the coal gas of our towns. In its present form, however, other gases are used, such as producer gas in its various forms, coke oven gas and blast furnace gas; light oils are used, as petrol; heavy oils are used, such as refined and crude petroleum; and even alcohol has been applied for the purpose of producing motive power. Hence the abandonment of the old term gas engine, and the use of the modern term internal combustion motor.

Motors in Competition.

Although the gas engine has made marvelous progress, both from the practical and the scientific points of view, yet its advance has been attended by no small advances in the mechanism and economy of the steam engine, and the development of an entirely new form of steam engine specially suited for large powers. I refer, of course, to the steam turbine. The steam turbine, so far as practical use is concerned, was entirely originated by the Hon. C. A. Parsons in 1884, so that it has attained to its enormous developments both on land and sea in the short period of twenty-two years.

The practical introduction of electricity, both for lighting and motive power, has also been accomplished in the same period. Little was known of electricity from a practical standpoint in 1876. Indeed, as late as 1881 the electric light was only beginning, and electric motive power was but little thought of.

The development, mainly in this country, of the high-speed reciprocating steam engine direct coupled to a dynamo, and the steam turbines also direct coupled, soon led to the comparatively economical production of electricity. Accordingly, we now find the following motors, all in competition one with the other:

Steam	Reciprocating. Turbine.		
Gas	Coal gas. Producer gas. Coke oven gas. Blast furnace gas.	Petrol, Alcohol.	Heavy oil.
Electricity.			

(*From a lecture delivered to the Sheffield Society of Engineers and Metallurgists, November 5th, 1906, at Firth Hall, Sheffield University.)

We can thus have motive power in a factory for any purpose, either from steam, in the form of a reciprocating slow-speed or high-speed engine, or in the form of a steam turbine, and in a town we can have an internal combustion motor using either coal gas, a producer gas, or a heavy oil. For stationary engines in towns, the other gases are not applicable, and petrol and alcohol are not preferred on account of their relative volatility and inflammability. The small user of motive power may also take electricity from the electric mains. Where lifts are operated, too, in many towns a high-pressure system of water supply is arranged.

ation. In these journals I find the case against gas, both for power and light, set forth with great detail, and sometimes with no little exaggeration. On the other hand, the reading of our leading gas journals is almost convincing that no good can some from electricity or electricians. There is no place so excellent as the gas journals for discovering the various troubles which occur in electric light stations, and in supplying electricity for motive power. Such competition is healthy and tends to progress.

Heat Efficiency.

HEAT BALANCE-SHEET FROM 1882 TO 1900, WITH OTHER PARTICULARS OF ENGINES.

Name of Experimenter.	Year.	Dimensions of Engine.	Revolutions per Minute.	Compression.	Expansion.	$\frac{1}{r}$	E Standard Air-Cycle.	Heat Proportions. I.HP.	Rejected in Water Circulation.	Rejected in Exhaust.	Difference Values.	Total.	$\frac{\text{I.HP.}}{\text{E}}$	Heating Value of Gas Taken.	Type of Engine.
		Diameter Stroke. Inches. Inches.													
Slaby	1882	6·75 × 13·7	160	PV^{1}	$PV^{1.37}$	$\frac{1}{2·66}$	0·33	0·16	0·51	0·31	0·02 radiation	1·00	0·48	Lower	Deutz.
Thurston	1884	8·5 × 14·0	160	..	..	$\frac{1}{2·66}$	0·33	0·17	0·52	0·155	0·155 conduction and radiation	1·00	0·515	Lower	Crossley.
Society of Arts Trials.	1888	9·5 × 18·0	160	$PV^{1.33}$	$PV^{1.435}$	$\frac{1}{3·5}$	0·39	0·221	0·432	0·355	..	1·008	0·565	Lower	Crossley.
Society of Arts Trials	1888	9·02 × 14·0	200	$PV^{1.245}$	$PV^{1.35}$	$\frac{1}{3·2}$	0·37	0·211	0·352	0·398	0·039 unaccounted for, including rejected in blank air charge	1·00	0·575	Lower	Griffin (6-cycle).
Kennedy	1888	7·5 × 15·0	210	..	$PV^{1.298}$	$\frac{1}{3}$	0·36	0·209	.	.	..		0·585	Lower	Beck (6-cycle).
Capper	1892	8·5 × 18·0	160′	$PV^{1.363}$	$PV^{1.374}$	$\frac{1}{3·4}$	0·39	0·228	0·389	0·405	..	1·022	0·58	Lower	Crossley.
Robinson	1898	10·0 × 18·0	170	..	..	$\frac{1}{5·17}$	0·48	0·287	0·33	0·383	..	1·00	0·60	Lower	National.
Humphrey	1900	26·0 × 36·0 2 Cylinders {A, B}	150 ..	$PV^{1.331}$ $PV^{1.319}$	$PV^{1.268}$ $PV^{1.204}$	$\frac{1}{5}$	0·47	0·278 0·315	0·242 in jacket water and exhaust valve	0·48	..	1·00	0·59 0·66	Higher Lower	Crossley. "
Witz	1900	51·2 × 55·13	95	..	..	..	0·55	0·28	0·52	0·20	..	1·00	0·51	Higher	Cockerill.

The Gas Engine with Town Gas.

The advocates of these various systems have, of course, much to say for themselves, and the general competition has resulted in the installation in works of motive power obtained in these different ways on quite a considerable scale. The fact is that each type of motive power has its own advantages and disadvantages, and there are varying circumstances which in different cases render one to be preferred before another.

I am here to-night, as an advocate of the gas engine in its old-fashioned form, that is, the internal combustion motor driven by town gas. I am not blind, however, to the good points of the steam engine or to the excellence of the electric motor, and I shall do all I can to avoid overstating my case.

A perusal of our excellent electrical journals furnishes interesting evidence of the enthusiasm of their editors for the cause of electricity, both as supplying power and illumin-

The development of the internal combustion motor has not been so startlingly rapid as that of the steam turbine, but in one essential point it assumed a leading position, and it has retained that position over all other prime movers. I refer to the heat efficiency of the engine. The early gas engines of the now prevailing compression type had an indicated efficiency of about 16 per cent. This efficiency has been slowly increased, until at the present time gas engines are in regular use having an indicated efficiency of 35 per cent., and even a little over. No steam engine efficiency can be compared with these figures. On this point the steam engine falls far short of the gas engine.

The accompanying table shows the gradual improved effect in the heat efficiency of the gas engine. From this table you will see that as years went on, the efficiency slowly increased, until some 30 per cent. of all the heat given to the engine was converted into indicated work. Since this table was prepared, the Report of the Committee of the Institution of Civil Engineers on the "Efficiency of Internal

Combustion Engines" has been published, and the results of tests are given with three National gas engines at the National Company's works at Ashton-under-Lyne. From these tests it appears that the brake-efficiency of these three engines, of 5-horse, 21-horse, and 52-brake horse, respectively, was 26.1, 28, and 29.9 per cent., respectively, and the gas consumption per brake horsepower per hour was 16.87, 15.84 and 14.9 cubic feet, respectively, with gas under 600 B. Th. U. per cubic foot.

Very similar results were obtained from Crossley engines by Professor Burstall in a recent test. I believe, however, on the Crossley engines, the compressions adopted were somewhat higher.

Study of Heat Losses.

In a paper read before the Royal Society in the early part of this year, I described a new method of studying the heat losses and other phenomena of the gas engine cylinder by means of a special indicator diagram. Those of you who are familiar with gas engine matters will know that many years ago experiments were made on the explosion and cooling curves of mixtures of coal gas and air in a closed chamber by means of an indicator registering upon a rotating drum. These experiments enabled us to determine the rate of cooling of an explosion when exposed in a vessel of certain dimensions, but having fixed walls. No method seems to have occurred to anyone of determining the rate of cooling in the gas engine cylinder itself with the piston moving. The experiments described in the Royal Society paper referred to by me very clearly show the rate of cooling in any cylinder. They consisted in taking a diagram from a compression explosion in the ordinary way, but so arranging matters in the engine that the exhaust valve and the charge inlet valve were held closed immediately the charge was taken into the cylinder. In this way, when the engine reached the exhausting point, no escape was possible, and the whole of the hot gases were compressed and expanded, producing a series of gradually rising and falling lines, which indicated exactly the loss of heat to the cylinder during the alternate movements of expansion and compression. Diagrams were shown illustrating these experiments.

Large Engines.

Gas engines by English makers are built and sold in very large numbers. At the present moment the weekly output exceeds anything before experienced in Great Britain, and engines of English construction are freely sent to nearly the whole of the Continent, our colonies, Japan, and even America. British makers have confined themselves mostly to engines up to 300 brake horsepower, as they have found these sizes, for the present, to be the more commercial. Continental makers have devoted themselves to larger engines, and engines have been built of considerable power. Of these large engines, two main types appear—Otto and Clerk. For the smaller engines in this country, the Otto cycle is practically supreme. Some English makers, however, have taken up the large engine problem, and are making good progress. At present the large engine is rapidly nearing the paying commercial stage. In using the term "paying commercial stage," I refer to the gas engine builder, and not to the user, because many large gas engines have been built and applied to the great advantage of the user, although often at a loss to the maker. The cost of these large engines has been too great; but there are methods of bringing it down, and I have no doubt in a very short time we shall have much more powerful large gas engines with very much less weight of metal, and consequently less cost.

POLYPHASE SYSTEMS OF GENERATION, TRANSMISSION AND DISTRIBUTION.*

By M. A. Sammett, A. M. Can. Soc. C. E.

Every electrical development possesses some typical peculiarities which should be the determining factors in the selection of the frequency of the system as a whole, as well as the selection of the generating and distributing systems as to phases, that is, whether it should be two or three-phase. These are the problems with which we will concern ourselves in the discussion of polyphase systems, with a transmission line of 100 miles or less and pressures up to and including 50,000 volts at the receiving end.

Whatever the generation and distribution, the transmission of power is always accomplished by three-phase. This arrangement allows of most economical transmission of power with a given drop in the line. While the transmission of power is invariably accomplished by three-phase, the generation and distribution is often by two-phase.

Modern engineering practice shows, however, the abandonment of the two-phase generator in connection with hydro-electric power houses, where power is to be transmitted and consequently transformed from two to three-phase. The common belief of the simplicity of the two-phase generator and switchboard is more imaginary than real and came about as a result of clinging to the more familiar two-phase generator which at the time just preceding the era of generation for transmission purposes was the standard apparatus, answering best the needs of small central stations with a lighting load, the amount of power forming a very small proportion of the total load.

It must be admitted that a two-phase system for distribution purposes is somewhat simpler to operate than a three-phase system. The two-phases may be controlled independently for single-phase lighting circuits, without any appreciable effect of one phase on the other.

In the case of motor connections on two-phase circuits, all that is necessary is to connect the two transformers with the primary coils to the line, and the secondary coils to the motor. No special attention is required as to polarities of transformers. The impedance of transformers need not be the same for proper division of load, as is essential in connections of three-phase installations.

It was this at first sight simplicity which appealed to the engineer in laying out the first hydro-electric power houses, and even at the present time some engineers persist in their preference for the two-phase generators, and at the receiving end go through another transformation from three to two-phase in order to supply two-phase current at the distributing end.

Let us take up the generating plant first and see which of the two systems, three or two-phase, is more efficient as well as more economical.

Power House.

It is pretty well known that for a given capacity, speed and voltage, at a given frequency, the three-phase generator will prove the more efficient machine. Manufacturers standardizing apparatus use the same frames and punchings for the two different types. This enables the manufacturer to turn out a better three-phase generator as to efficiency and heating, retaining the same core loss. Should he, however, select to keep the same density in the copper of the three-phase as in the two-phase machine, he will be in a position to reduce the magnetic flux by virtue of the larger number of turns that can be accommodated in the same slots, and thus considerably reduce the core loss. Inasmuch as the

*From a paper read before the Canadian Society of Civil Engineers, November 15, 1906.

core loss in machines of large capacity is considerably greater than the copper loss, this will result in a material increase in the efficiency of the generator.

Switchboard.

Taking up next the switchboard, we will find that the only advantage the two-phase board has in comparison with the three-phase, is the saving of one ammeter.

All busbars, oil-switch contacts and switch compartments, all cables from generators to switchboard and from the board to the transformers are reduced in the ratio of 4:3, and while 15.6 per cent. larger cross-section of copper is required in the instance of the three-phase installation, maintaining the same current density, the 25 per cent. saving in the number of individual parts necessary for the installation will be in favor of the three-phase board.

Transformers.

The use of two transformers for a given load allows a greater individual transformer capacity, and therefore a more efficient transformer. This would have been a decided advantage, favoring the two-phase system, were it not for the fact that the transmission of power is to be by three-phase. To accomplish this phase transformation by the well-known Scott connections, unless all transformers are provided with a heavier high-tension winding, the transformer capacity would of necessity be reduced, due to a higher current in the three-phase winding, namely, that of 115.6 per cent. of the normal current. Should, however, the transformers be designed with provision made for this higher current, it would necessitate larger transformers, or in other words, a more expensive installation. Beside this increased transformer capacity another disadvantage must be added, that of a possible resonance with T-connected transformers for two-phase three-phase transformers. Whenever one of the phases is open, due to a failure of making proper contact of various switches or any of the auxiliary connections, the high reactance of the high-voltage transformer will get in series with the capacity of the transmission line and a resonance is likely to take place with the consequent disastrous results.

We have shown the advantages of using a three-phase generator. This advantage is further augmented by the possibility of using transformer connections with which the danger of resonance is eliminated. Of the transformer connections in vogue, there are two which are free from the danger of resonance, namely, delta to delta for step-up and delta to delta for step-down, or delta to Y and Y to delta. Neither of these two has the objectionable characteristic of resonance, and while the delta to Y and Y to delta is selected for transmissions where highest voltages are made use of, it is the delta to delta which gives the most reliable service. With the latter style of connections, should one of the transformers fail, as soon as this transformer is cut out, the service may be restored. This latter connection, which insures both continuity of service and freedom from resonance, is introduced now on one of the 60,000-volt transmission lines and is destined to become the standard, inasmuch as high-tension transformers of 60,000 volts as well as the insulators, especially if the latter are carefully selected and tested, have the requisite factor of safety, making the resort to the Y connections, at a sacrifice of continuity of service, unnecessary.

Distributing System.

The considerations which held true in the discussion of the transmission line will also hold true in the distributing system. The three-phase delta connections should be made use of, since on motor service a complete shut-down due to a failure of one transformer must be carefully guarded against. Again, the three-wire three-phase distribution will result in a saving of 25 per cent. of copper and insulators. It will reduce the maintenance expense by the same percentage.

The advantages thus enumerated show clearly the desirability of three-phase distribution from the purely commercial standpoint and still more so from the point of view of reliability and permanency of supply. Some engineers object to the three-phase distribution on the ground of the difficulty of balancing loads. This objection must not be given much importance. With the mixed load of lighting and power, the power load has an equalizing tendency on the balancing of the system, and with some attention given to the proper division of the connected lighting load no difficulty will be encountered.

The station records should be carefully watched, and occasional readjustment of the load, based on station records as well as tests of individual installations, will permit of as careful a balance as one may desire.

The comparison of motors can best be made from a summary of a convention paper by Mr. Bradley McCormick, read recently before the American Institute of Electrical Engineers. Given two similar frames without windings, how shall the two-phase and three-phase windings differ in order to secure proper operation? What will be the comparative losses if the two machines are given the same rating?

Mr. McCormick's answer to these questions is as follows:

1. A two-phase machine should have 22 per cent. more conductors per slot than the corresponding three-phase Y connected machine, designed for the same voltage and flux per pole.

2. The magnetizing current is the same in both the two and three-phase machines when expressed in percentage of the current, which corresponds to the full-load output.

3. The copper loss of the two-phase machine is 12 per cent. higher than that of the three-phase.

4. The leakage factor of the two-phase machine averages 25 per cent. greater than that of a three-phase machine, therefore the power factor is lower.

Actual results show from 1 to 3 per cent. lower power factors.

These considerations show that the two-phase machine will have a higher temperature rise as a result of a higher copper loss. For the same reason the efficiency of the two-phase motor will be lower. The slip of the two-phase machine will also be greater. Tests and theoretical calculations show 20 per cent. greater slip.

Thus we see that the two-phase induction motor is a poorer motor for the central station company, due to a poorer power factor. It is also less advantageous to the power user, as a smaller efficiency means a larger motor input for a given output. The higher temperature rise will result in a shorter life and larger slip will mean a greater fluctuation between synchronous, partial and full-load speeds.

While the three-phase service should be made standard, two-phase motors may be used by the aid of three-phase two-phase transformers. This, however, should be discouraged, as such transformers require special taps, which make them more expensive, especially so when core type transformers are used. It also means the carrying of a stock of these special transformers as spare units.

Frequency.

The frequencies most widely used on this continent are those of 60 and 25 cycles. While other frequencies are made use of, these are the predominating ones.

As far as the transmission line is concerned, the lower the frequency, the less the induction drop, the smaller the charging current and the better the regulation. It is a foregone conclusion that as a purely transmission problem we will have to adopt the 25-cycle frequency.

The speeds of turbine-generator units are limited by the number of wheels, type, head and output. Therefore a wider range of speeds permissible with a 60-cycle system will enable

the selection of the most efficient generator-wheel combination.

The switchboard under the two frequencies is unaffected. All meters and potential and current transformers are designed for satisfactory operation on frequencies from 25 to 125 cycles.

The transformers built for 25 cycles are a much more expensive piece of apparatus as well as less efficient than when built for 60 cycles. Considering that there is with a generation, transmission and distribution of power a total transformer capacity equivalent to from three to four times the capacity of the generating apparatus, one will readily see the advantage of a higher frequency. This, however, must not be done at a sacrifice of other considerations, such as excessive charging current in transmission or extremely poor regulation.

With incandescent lighting, while 30 cycles is the limiting frequency, 40 cycles is unsatisfactory when moving objects are viewed by it. On this continent 60 cycles is the standard frequency for such a service, while 50 cycles is European practice. For arc lighting 40 cycles is the limiting frequency. Lower frequencies are made use of in the application of the recently developed mercury vapor converter and magnetite lamps. This new system, however, will probably have to go through a process of further experimenting. The conservative investor will still select the higher frequency series alternating enclosed arc lamps.

Analyzed from the standpoint of frequency, induction motors show characteristics which make it difficult to decide as to the best motor. As a rule lower frequency motors are adaptations to standard 60-cycle frames and punchings, hence their performance does not show characteristics of the same high standard. Of course the low frequency motors have advantages of their own, such as better starting torque, higher instantaneous but not continuous overload capacity and lower speeds.

The principal factors in favor of the 60-cycle motors are better continuous overload capacity and also a cheaper product commercially as a result of higher speeds. Therefore, with equally good performance as to efficiency and heating, the 60-cycle motor will still be ahead of the 25-cycle motor.

The suitability of low frequency synchronous converters for railway work is a well-established fact. While 60-cycle synchronous converters are used for such purposes, they are rather an exception and their operation is less satisfactory. What should then, under the circumstances, be a desirable way of supplying street railway loads without resort to frequency changes? The latter are out of the question, due to excessive cost, beside the great reduction in the efficiency of the systems, resultant from their use.

Motor-generator sets may be and are advantageously used in this connection, and while not possessing the advantages of 25-cycle synchronous converters, have features which make them particularly suitable for use on long-distance transmission systems, permitting of a partial or complete control of the power factor of the system depending as to whether induction motors or synchronous motor sets are used.

Wherever large capacity is present, due to long transmission lines, induction motor generator sets of large size can be used to great advantage. For perfect control of the power factor of the transmitted power, synchronous motors should be employed, as in this case the regulating of the field excitation allows of a close control of the power factor of the transmitted energy, allowing the maximum energy for a given current, and under certain conditions will permit of carrying the load at unity power factor in the generating and transforming apparatus and transmission line.

While the synchronous converter is the most efficient of the three means of supplying railway loads, whenever this load constitutes only the minor portion of the total output of the plant, the interests of the lighting and power load cannot be sacrificed for a most efficient conversion of the alternating current to direct current for railway purposes.

In our discussion of frequency we may conclude that for a mixed load of lighting and power with a railway load not exceeding one-third of the total power generated, 60 cycles will be the frequency to select.

The regulation and capacity or charging current are decidedly in favor of the 25-cycle transmission. The results for the 60-cycle system, while considerably in excess of those at 25 cycles, are considered quite normal for commercial purposes, and inasmuch as the increase and decrease in the load is gradual the regulation is well within control of the central station operators or automatic devices.

As to the railway load, this had better be carried on a separate circuit, whenever a multiplicity of circuits is used in transmitting the power. In our case there are three transmission circuits.

Considering the successful operation of one of the long-distance transmission lines of 150 miles in California, where the charging current forms 40 per cent of full-load current, and where the regulation is 40 per cent. at full load, 80 per cent. power factor, we need not hesitate to operate our line with a regulation of 23 per cent., 80 per cent. power factor.

The power factor of the system, however, is to a large extent within the control of the operating company, as it may recommend to power users such apparatus as will best answer the purposes of the system as a whole. Beside this, by employing synchronous motors running as rotary condensers, it will be enabled to regulate the power factor of the system and keep it if necessary at unity. These synchronous motors running idle, used supplementary to the synchronous motor-generator sets, will allow of a perfect control of the power factor of the system, reducing the regulation to 9 per cent. under full-load condition.

In conclusion, we will say that under the conditions as stated, for a mixed lighting and power load, with a railway load not exceeding 33 per cent. of the total output, a three-phase, 60-cycle system should be employed throughout and all transformation should be accomplished by delta to delta connection.

LIGHTING AND SUCTION GAS FOR POWER PURPOSES.

An abstract of a test carried out at Munich for the purpose of comparing ordinary lighting gas with suction gas is given in a recent number of "Elektrotechnik und Maschinenbau." The test was made on a 36-h. p. engine having a 250-mm. diameter cylinder and a 400-mm. stroke. The best results with lighting gas were obtained at a load of 35.9 i. h. p. (which was almost the maximum load), and showed that 42.7 per cent. of the available heat was converted into indicated horsepower, 33.2 per cent. was lost in the cooling water, whilst the remaining 24.1 per cent. was lost in the exhaust gases, etc. The average speed was 210.7 r. p. m., the average indicated cylinder pressure 114 lbs. per square inch the minimum, heat value of the gas was 500 B. Th. U. per cubic foot, and the hourly consumption 395 cubic feet (reduced to 0 deg. C. and 735.5 mm. pressure), giving a consumption of 11 cubic feet per indicated horsepower hour. The suction gas test was made at nearly the same load (34.9 i. h. p.). The speed was 210 r. p. m., the average cylinder pressure was 112 lbs. per square inch, the heat value of the anthracite used was 14,000 B. Th. U. per lb., and the consumption of anthracite per indicated horsepower hour was .75 lb. gross (including the heating-up and burning-out periods), or .63 lb. net, counting only the coal used whilst the engine was at work.—"Electrical Engineer" (London).

SOME POINTS ABOUT SINGLE-PHASE MOTORS.*

By W. Langdon-Davies and F. B. O. Hawes.

The title of this paper will, it is hoped, be sufficient to prevent you from anticipating more than some brief sketches of a few matters of interest relating to single-phase motors. The types of motors dealt with are those which are used on ordinary single-phase circuits, supplying current for lighting and power, and not with those for traction, etc., working on special low-periodicity circuits. The whole subject is full of interest, but only a small portion can be touched on in the scope of one paper.

One of the earliest, if not the earliest, motors run by a rotating field was that devised by Walter Bailey. In his arrangement the shifting of the magnetic axis of the field, commonly called the rotating field, was produced mechanically by means of a commutator, which, although attached to the rotor, really commutated the field and caused it to more or less rotate. Direct current was used. This machine is worthy of much the same admiration that one bestows on, say, "Puffing Billy," when one considers the difficulties which beset the early pioneers. The shift'ng of the magnetic axis can be produced by other than mechanical means.

Who was the actual first inventor of the commutatorless single-phase motor starting on split field and subsequently working on a single-phase impressed field is not certain. It was probably invented by more than one person practically at the same time. Professor Ferraris, in a lecture, demonstrated this method in March, 1888. At about that time Nikola Tesla obtained and held patents in America, England and elsewhere for producing the same results. Touching these early patents of alternating-current motors, there is one that will probably interest you—namely, that taken out by Dobrowolsky, dated December 15, 1890, for the introduction of resistance into the induced member, usually the rotor, at starting. This is of particular interest from a commercial point of view, as the patent was kept in force in England during its full time, expiring December, 1904. Although the owners of the patents appeared indifferent to their rights, English makers were restrained from making motors with slip rings. The patent was held by a foreign company.

The first experimental machine made by Mr. Langdon-Davies, which ran at all was constructed at the end of 1891. This was really a three-phase motor, the three phases being obtained from a single phase by splitting the phases, this being accomplished by inserting resistances in two of the circuits of the motor and no resistance in the third. The two resistances were, of course, of different values. The idea of phase-splitting was suggested by the results of some telegraph experiments. The stator and rotor were each ring-wound, and had polar projections, similar to the field magnet of a direct-current motor. No worse way of building an alternating current motor can be imagined, but if you remember that there was no common knowledge of the subject fifteen years ago you will realize that a pioneer had to discover these things for himself, and that his most useful discoveries arose from his mistakes.

The next machine—which was a two-phase motor—was wound with two separate windings on alternate poles for each phase. Two phases were obtained from a single-phase supply by the now common means of inserting a choke in one winding and a non-inductive resistance in the other. The rotor was a squirrel cage. The machine required a very large current to get it to start, and was very inefficient, and naturally had a very low power factor.

*Paper read before the Birmingham (England) and District Electric Club, Oct. 13, 1906.

Realizing that salient poles had serious disadvantages, the next machine was made with slotted tunnel windings with one pair of tunnels for each pole. There were two sets of poles wound with two separate windings, each winding being upon alternate poles. Both sets of poles and windings were used at starting; a variation of phase between the two sets was obtained, as before, by inserting a non-inductive resistance in the one set and a choke in the other. When the speed was nearly synchronous, one set of coils and the resistance and choke were cut out of the circuit and the machine ran as a single-phase motor. This machine, again, took a very large current at starting and was very inefficient.

It became apparent that the idea of having separate poles was a fundamental error. Separate poles may be considered as producing an effect on the rotor somewhat like that of a ratchet and toothed wheel, whereas what is required is a magnetic action upon the rotor which may be likened to the bristles of a brush continuously sweeping it round. The rotation of the rotor is produced by the field of the stator generating current in the rotor, which, again, produces a field reacting on that of the stator. When the rotor is revolving at nearly synchronous speed, the axis of its field should be as nearly as possible ninety degrees behind the axis of the stator field in the case of a two-pole machine. This can not be the case where there are separate poles, because there are points between the poles where the rotor has no effective return path. It was evident, therefore, that the whole of the interior surface of the stator must be magnetized both when running as well as when starting. In this motor such was not the case. In starting it will be seen that, when the alternate sets of poles were at zero they were inert, and when running, one set of poles was permanently inert.

This machine was rewound so that the starting and running coils each enclosed the whole magnetic circuit. By this arrangement both the magnetic fields of the rotor and stator when running, or the fields set up by the two windings when starting—to express the action in a very unorthodox manner—were better mixed together, and there was no position at any moment when the magnetic circuit of the rotor had no effective return path. This machine was a great improvement on its predecessors, and was the first machine which did really useful work. An important point to bear in mind as regards this machine was that every turn of the windings surrounded the whole of each of the poles. Consequently, owing to the varying reluctance, the field varied in density from a minimum at the center of a pole to a maximum on its edge, and a good rotating field could not be obtained. This motor had much to be desired in the way of efficiency. The next machine was built up of stampings having four slots per pole; this was a distinct advance on the previous machines. All these early efforts were made some fourteen years back. At the present date, thanks to the knowledge gained by the pioneers of the industry, the building of good single-phase motors is more a mechanical than an electrical problem.

Four properties are essential to a good single-phase motor—namely: (1) efficiency; (2) a high power-factor; (3) it should not overheat (though heating does not always indicate inefficiency); (4) it should be mechanically sound.

There are two other properties which are commercially useful, but have no other importance—a motor should be cheap and should look attractive. The last factor is a very variable one and we have not as yet found any reliable formula for it.

Dealing first with high power-factor. The power-factor of a motor matters but little to the consumer. He need not consider what current ebbs and flows through his meter, he only regards the watts the meter registers against him. Further, the additional amount of copper required adds nothing to his working costs, and but little to his capital

outlay. Up to a certain point, however, it does matter to the supply station inasmuch as it entails more loss on the conductors, or, to put it another way, more copper to supply the same power at a lower power-factor.

The efficiency of a motor is not essentially important to the supply companies, the more watts per horsepower it consumes the better in some ways for the supply company. We do not for a moment suggest that a supply company would, or, in our experience, ever has attempted to, get inefficient motors used by its consumers, but we do wish to impress upon you the relative values of power-factor to efficiency in a commercial sense.

The term power-factor is in itself misleading. It suggests to many people that a high power-factor means a high power of some kind, whereas what it really means is that a machine which is described as having a high power-factor is one which really requires a small magnetizing current, and for that reason we prefer to call the wattless current the magnetizing current. All motors require a magnetizing current, even direct-current motors, but the difference between the magnetizing current of a direct-current motor and that of an alternating-current motor is that in the direct-current motor the whole of the current is wattful, if we may use the word, whereas in alternating-current motors the bulk of the current is wattless. In the case of the direct-current motor, the whole of the magnetizing current is recorded in watts on the meter through which the motor takes its supply, whereas in the case of the alternating-current motor none of the really magnetizing current is recorded. The only portion of the alternating current which is recorded is that which either does useful work or is dissipated in hysteresis, mechanical friction, Foucault currents and copper losses. In the case of the direct-current motor, however, the magnetizing current may be very small, whereas in the alternate-current motor the magnetizing current must be comparatively large. The loss on the mains between the supply station and the meter is C^2R, therefore the smaller the current supplied to the motor for a given horsepower the cheaper the supply will be.

It is therefore advisable on general grounds to have as small a magnetizing current as possible. It is not a difficult thing to produce an efficient alternating-current motor, provided the amount of magnetizing current can be ignored. The chief losses are due to Foucault currents, hysteresis and C^2R in the copper. Good lamination of the magnetic circuit reduces the Foucault currents. Good quality of material reduces the hysteresis currents as well as the reluctance. Plenty of copper reduces the copper losses.

The third requirement is the one that gives the most trouble in construction, for the larger the amount of copper wound the more difficult it becomes to keep down the reluctance of the magnetic circuit and therefore keep down the magnetizing current.

There are three ways employed for getting the wire on to the iron: (1) Open slot winding (sometimes with former-wound coils); (2) tunnel winding; (3) combinations of the two.

Open slot winding decreases the area of the air-gap for a given diameter of rotor. Tunnel winding is apt to increase the magnetic leakage. Both of these increase the required magnetizing current in proportion to the power obtained, therefore various compromises are used.

The length of the air-gap is a most important factor in reducing the required magnetizing current. It can, in practice, be reduced to as little as 1-32 inch, but with so small an air gap as this the rotor must be very accurately centered. If it were 1-128 inch out of center, this would cause the length of the air?gap on one side of a diameter to be in proportion of three to five of the gap on the other side; a serious concentration of the field to one side of the rotor would result, thereby producing a considerable and useless side pull which would impair the starting qualities of the machine. This side pull is most serious in a two-pole machine.

Ordinary bearings soon wear to the extent of 1-128 inch, and the absolute necessity for some better bearing was demonstrated. The bearing which, in our opinion, best supplied the necessity was one constructed by our company, which was of highly-polished cast iron, a steel spindle being employed. The bearings were ring-lubricated and worked exceedingly well if kept properly lubricated and clean. For example, the company has now a six-brake-horsepower motor running in their works which has been going for ten years, and the bearings have never yet been touched. Unfortunately, these bearings had to be given up because it was found impossible to get the general user to attend sufficiently to the lubrication, especially in seeing that dirt was kept out of the oil. In the case of starting a new machine, it was absolutely necessary to see that the oil was working well through the bearings before running up to speed, as if they were dry it only took a fraction of a second for them ti seize.

There have been cases in which the users filled up the oil-box, which was fitted with a ring lubricator, with grease, and then switched on. The shaft seized, naturally, almost at once, and they could not be convinced that this was the result of their own neglect, but regarded the motor as a very bad machine electrically and mechanically. Good phosphor-bronze bearings have, however, been found to satisfy the general conditions.

Passing on to the consideration of rotor winding, it is absolutely necessary, in getting on the requisite amount of copper, to keep the area of the air-gap as small as possible. The earliest form of short-circuited induction rotors were wound (if it may be called winding) by thrusting a number of rods through poles in the rotor and soldering them to copper rings at the two extremities of the rotor; this was known as the squirrel-cage rotor. The holes in the rotor were placed as near the periphery as possible to avoid magnetic leakage.

Such a rotor may give trouble in construction, inasmuch as it is difficult to ensure that the copper squirrel cage is exactly concentric with the magnetic circuit of the rotor. Although the rotor might be mechanically balanced, it is possible for there to be a squirrel cage of copper inductors moving eccentrically to the field, which will produce starting difficulties. If the rotor is wound either with copper rods or bars in open slots, troubles arising from eccentricity of the copper produce little or no effect. After some years of experience and experiment my company has adopted for its short-circuited rotors a form of open slot winding. The slots can hardly be called slots, they are more of the nature of saw cuts, which are filled with copper strip. By this form of construction sufficient copper is put upon the rotor and a large area of air-gap maintained.

Passing on to the third property that a motor should possess—namely, that it should not overheat—you will remember that we said this did not always indicate inefficiency. This can be readily understood if you consider that if a well-designed motor which ventilated itself were shut up in a box it would soon overheat. The question of heating is one that requires careful consideration. If the efficiency is not affected it does not really matter how hot a motor gets, unless its temperature is such as to cause damage to itself or its surroundings. For instance, picture a 100-brake-horsepower motor of ninety-five per cent. efficiency. The remaining five per cent. or five brake-horsepower, whatever way you like to take it, has to be dispersed in heat, and it is essential that this heat should not produce in any part of the motor such a temperature as to become destructive to the insulation or any other part of the machine; but it should be understood that, provided the temperature of a motor is not sufficiently high to be either destructive to the machine or its surroundings, its actual thermometric measure does not matter.

This brings us to the question of ventilation, which is a most important one, and we venture to say much more difficult in an alternating than in a direct-current motor. The ventilating spaces between the pole pieces do not exist in an alternating-current motor, and as the stator has to completely surround the rotor there are no spaces for the air to circulate in. It will be seen from the rotor on the table, that a circulation of air is produced by providing the rotor with blades. These throw the air out from the center and are shaped so that the same effect is produced whichever is the direction of rotation of the rotor.

So far, we have only considered short-circuited rotors. These, of course, have a comparatively small starting torque per ampere. It should be remembered that it is only the starting torque per ampere that is of importance. An ordinary squirrel-cage rotor can be made to give a large starting torque if the stator is so wound as to give it a large current.

The efficiency of a motor when running up to speed is also a point worthy of careful consideration. In such cases as cranes and lifts, where the motor is practically always starting, it is especially important that it should be efficient when running up to speed. This is not so, however, when a motor is used to drive the shafting in a factory, and is only started up, say, twice a day, the time of getting into speed being a minute fraction of the total time the motor is in action.

A larger starting torque is obtained per ampere where the rotor has slip rings and a resistance is introduced into the rotor circuit. This, however, introduces complications. H. M. Hobart, in his book on electric motors, admirably sums up the case. He "would employ the squirrel-cage type of motor much more generally as having such great advantages on the score of simplicity, robustness, better economy in operation, and cheapness in manufacture, as to justify its use, not only in very small sizes, which is the present practice, but also in practically any size, in fact, limiting the use of slip-ring motors to special cases. It is true that squirrel-cage rotors must be started with little or no load, and even then must be started from a compensator, in order to limit the starting current to a permissible amount, but by the use of mechanical devices designed to apply the load after starting, they are made not only equal to, but more satisfactory than, the slip-ring motor, being characterized by higher efficiency, power-factor and overload capacity, and requiring a minimum of attention. The slip-ring motor, on the other hand, is not only less satisfactory with respect to these constants, but it is inherently more expensive, more liable to break down, gives at the slip rings and brushes practically as much trouble as a commutator, and must have troublesome and expensive auxiliary attachments for internally short-circuiting the slip rings and raising the brushes after starting. All these disadvantages are encountered simply in order to obtain improved starting."

So far we have chiefly discussed some mechanical points about a single-phase motor, but the question of starting at once brings us to the unseen, and, we venture to say, the most important, consideration—viz., the rotating field by which the motor is started. Supposing a rotating field to be set up in the motor, in order to obtain the best results its speed of rotation should be perfectly constant, and it should not vary in strength during each revolution. This result is practically unobtainable in a split-phase motor, as certain compromises have to be made. For example, take the case of a two-pole machine, and consider what is really required to produce a rotating field. The field should be perfectly uniform in density all round the air-gap. This in itself is a difficult condition of affairs to produce in practice. Since tunnels of some kind must be used to contain the stator winding, it is obvious that the reluctance across every diameter of the air-gap is not uniform, and therefore the magnetic field in the air-gap cannot be uniform. Any want of uniformity in the rotating field produces wasteful currents in the rotor. Modern methods have, however, reduced these irregularities by careful design.

There is, or was, one difficulty in getting single-phase motors to start which we think will interest you, although with modern alternators it is a thing of the past. We refer to the wave shape of the alternating current supplied to the motor. Some of the most astonishing results may arise from irregular wave shapes—viz., those which are not sinusoidal. For instance, with a double-crested wave, a condition which frequently used to occur in practice, the resultant magnetic field would not only cease to revolve, but twice in a revolution it turned back against the direction of rotation of the rotor. It is obvious that under such conditions there will be great difficulty in getting the rotor to run up to speed.

The whole of this subject is so extensive that it is impossible to know when to stop, but it is hoped that the above points will be of some interest.

VOLATILIZATION OF METALS.

The results of experiments to volatilize the metals belonging to the platinum group by means of the electric furnace were recently detailed before the Academie des Sciences by M. Henri Moissan. Melting took place readily with all these metals when a current of 500 to 700 amperes at 110 volts was used. With 500 amperes of current, 150 gm. of platinum reached the melting stage in one or two minutes, and four minutes later that of evaporation. Ruthenium, palladium, iridium and rhodium were evaporated with the same amount of current, but osmium required 700 amperes. The distilled metal resulting from the treatment of the same weight of metal in each case (150 gm.) was as follows: Osmium, 29 gm.; ruthenium, 10 gm.; platinum, 12 gm.; palladium, 9.6 gm.; iridium, 9 gm.; and rhodium, 10.20 gm.—Electrical Review (London).

SAN DIEGO MEETING OF THE CALIFORNIA PROMOTION COMMITTEE.

The most important meeting ever held by the Counties Committee of The California Promotion Committee, so far as results beneficial to the State are concerned, was that held in San Diego on Dec. 15th, in which representatives of fifty-one of the fifty-seven counties of the State participated. At this meeting papers were read which put forth the needs of all the harbors of California, and also the interdependence between the harbors and the various industries of the State. As the meeting was that of a State organization, no attempt was made to devote attention to individual interests of the harbors; but it was the opinion of the delegates that all efforts should be centered upon work that would improve all the harbors of California, as in this way the whole State would be benefited by the work of the committee.

Resolutions were passed requesting Congress and the Governor of California to appoint commissions who will examine into the needs of the harbors of this State and recommend such improvements as are deemed desirable. The Legislature is asked to enact laws and vote the appropriations necessary to put these recommendations into effect.

It was decided to call a meeting of the Advisory Committee to be held in Sacramento on Jan. 11th.

At the meeting of the Joint Committee of the Electrical Development Association, held in New York on December 13th, a resolution was passed expressing confidence in the program outlined for the future development of the association. Three committees of five members each were appointed to make a report on the following respective subjects: Constitution and by-laws; membership assessments; commercial program. The association hopes to effect a final organization at its next meeting.

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EDITORIAL.

San Francisco's New Year

San Francisco is busy. We may not have all the material comforts with which we were surrounded at this time last year, but, while we thought then we had all we possibly could do, we really did not know what it is to work every hour in the day, and as a result, have the pleasure of seeing our efforts quickly materialize in a concrete result.

To the engineer, no place in America can be of equal interest with San Francisco today. No one appreciates better than the engineer how much to be preferred it is to begin entirely new as compared with the attempt to repair or alter or enlarge an old obsolete installation or structure. San Francisco has begun with a clean sheet, not to mention the work of clearing up the debris resulting from three days' destruction, and for modern, up-to-date construction of the highest class, this city will eventually be among the best in America.

It is not to be supposed, however, that this can be accomplished in a few months or a year, but it is being done day by day most consistently, and the beginning of the year 1907 witnesses the work well under way.

It is marvelous when one considers the extent of the reconstruction done and the results accomplished by the electric light, and power, gas, street railway and telephone companies. It is not as if each or any of these public utility corporations were able to immediately proceed with their new construction, but from the very first, business greater than ever before had to be carried on at the same time the new construction was being prosecuted. Nor was there a moment's delay. No one even queried whether the restoration of all such public service was to proceed or not. It was taken for granted from the very beginning that these installations were not only to be rebuilt, but the new plants were to be better than ever before.

San Francisco occupies a unique position among the cities of America. Its location, geographically, marks its essentially as a commercial city. Today more business is being done than ever before in its history, and probably more than one-half of its business is being done in temporary buildings, but the modern sky-scrapers are also being rushed to completion. It is said that, for the most part, the necessary money is coming primarily from San Francisco and California to rebuild the city. While this may be true from the standpoint of the new buildings, it is not the case with the reconstruction of the gas, electric light and power, street railway and telephone companies. These public utility corporations are largely controlled in the East, and it is with gratitude that the San Francisco people have witnessed the unlimited support these eastern interests have given to the local managers in reconstructing their damaged plants.

Due to the great industrial development of the past ten years, particularly for the use of the transportation, electric light, power and gas interests, San Francisco today has cheaper fuel and cheaper power, and at the same time is very largely independent of the supply of coal which up to within the last few years has always come to San Francisco from outside of the United States. Fuel oil for the generation of steam power has practically entirely replaced coal, and the extensive development of electric power transmission from the mountains has made it possible for San Francisco, and in fact all California, to get a large part of the required power, independent of coal as fuel, which has always been expensive in addition to being limited in quantity. San Francisco's predicament at the present time from the power and fuel standpoint can be easily imagined, if with the present serious shortage of coal the entire city and its power and light plants were dependent upon such supply of coal. Fortunately, the oil fuel supply and electric power transmission has solved this problem, it is to be hoped, for all time.

San Francisco looks forward to a most prosperous New Year. The co-operation of all interests should make Nineteen Hundred and Seven the greatest year in the history, not only of the City of San Francisco, but the entire Pacific Coast.

TRADE CATALOGUES.

The Electric Storage Battery Company, of Philadelphia, has recently issued a folder describing the application of "Chloride Accumulators" and Exide Batteries to railway signal and interlocking systems. The folder contains an interesting table showing the rapid increase in the use of these batteries for this class of work, and gives illustrations of several of the types usually employed in signal service. Illustrations are also shown of batteries of "Chloride Accumulators" in place in semaphore towers.

The Chase-Shawmut Company, Newburyport, Mass., is now sending out its latest bulletin, No. 36, in which is listed the full line of fuses and fuse fittings manufactured by this company. These include the N. E. code enclosed fuses of carrying capacities up to 600 amperes, porcelain single pole bases especially for 30 and 60 amperes on 250 and 600-volt circuits, double and triple pole cutouts, special contacts, etc. The "Shawmut" extended terminal enclosed fuse is a new product popular with the jobbers, and fits any type A block of Noark, D. & W. or Shawmut manufacture. The bulletin is amply illustrated.

Crushing machinery for breaking up coal, rock salt, phosphate rock, etc., is rapidly coming into extensive use in many industries. The Allis-Chalmers Company describe in Bulletin 1419 several patterns of this class of machinery. The difference lies mostly in the character of the rolls, which is determined by the hardness of the material and ultimate size required. Removable steel teeth are usually recommended, though teeth cast on segments for bolting to the rolls are also made.

Bulletin 1501 of the Allis-Chalmers Company is devoted to belted Corliss engines of the "Reliance" pattern. Though the first Reliance engine was built less than three years ago, an unusually large number of them are already in operation, giving great satisfaction. These engines are of the high speed type and occupy less floor space than is required by engines constructed according to the usual Corliss practice. There are many half tones to illustrate the most important constructive features.

The Allis-Chalmers Company has also issued a leaflet giving the principal products manufactured, the various works owned, and the many district offices which this company has established all over the world.

Some recent publications of the Allis-Chalmers Company, Milwaukee, Wis.:

Bulletin No. 1503. Here is given a description of the Reynolds-Corliss engines built by the Allis-Chalmers Company for driving electrical and other fast running machinery by direct connection or belting. These engines are of the "Reliance" pattern.

Bulletin No. 1510. This is devoted to Reynolds-Corliss engines of the heavy duty pattern. They are made either horizontal or vertical or combined, simple or compound, condensing or non-condensing, and for triple expansion.

Folder No. 4001. This describes the Reliance friction clutch. These clutches are built in sizes for loads ranging from 8 to 425 horsepower at 100 revolutions per minute.

PERSONAL.

Mr. Rudolph W. Van Norden, consulting engineer, who has had offices in Oakland since the fire, has again established himself in San Francisco in the Mutual Savings Bank building.

Mr. E. Dewald, manager for the Platt Iron Works, left for the East on Friday, January 4th.

FOR THE STUDENT.

All things are more or less hard to do, and only work will do them. Get a right idea of work. Don't trust to cleverness. It is worthy, but it will not do your work. Accomplishment demands singleness of purpose and concentration. All exterior forces tend to diversion from these essentials. Here you come in again to show your triumph of personality over environment. No matter what you do, from the humblest incidental thing of the moment to the consummation of your greatest ambition, the same principles of human activity apply. All will be clear sailing until you meet resistance, and sometimes you will run against it hard. Then you will find whether you have nerve or nerves. No one can help you much. Your measure is being taken, and you win or lose upon the cumulative ability which you can muster as the total assemblage of native talent and all that has become a part of you through all the influences that ever entered your life. See to it that they all shape one way. You will meet some disappointments through your own faults and some because the world is not exactly just, but whoever gets approximate justice in the world is doing very well. The perfectionist has a hard time. He meets continual disappointment, especially if he is chiefly worried about the imperfections of others.—Mr. W. C. Kerr, before the students of the Staten Island Academy.

TELEPHONING ACROSS THE MISSOURI.

Owing to the constantly changing bottom of the Missouri River a cable is not considered practical and the telephone wires connecting Council Bluffs and Omaha are suspended from a steel tower on each bank, 110 feet high. These towers are built of galvanized iron and each will sustain a strain of 20 tons. The guy ropes are carried back 700 feet and anchored to heavy concrete blocks.—"Popular Mechanics."

GAS EXPLOSIONS.

In his address before the Michigan Gas Association, Mr. W. H. Barthold pointed out that a large number of disastrous accidents occurred during the past year from gas explosions. They have not only destroyed portions of plant, but caused loss of life. "We boast," said Mr. Barthold, "of the progress we are making in all branches of the gas business, but the increasing number of accidents indicates that some companies are not improving in one respect—that is, in discipline among their men. The fault lies in the management. Some gas managers neglect to issue and enforce instructions to their employees, that are necessary to make our business a safe one. Employees in all departments should be taught to use extreme care and judgment in the performance of their duties. This can only be done by enforcing proper instructions for their guidance."

TROLLEY-HOLDING DEVICE.

James O'Neill, a locomotive engineer for the Spokane Falls & Northern Railway, has invented a device to prevent street car trolleys slipping from the overhead wires. It has been tested on Spokane lines and found to be satisfactory. The device consists of two clamps adjusted to the pinion of the trolley wheel. The ends of the clamps lap over the ridge of the wheel and form a shoulder, against which the wire butts whenever the pole becomes unsteady.

HYDRO-ELECTRIC PLANT EFFICIENCY.

The efficiency of an hydro-electric plant may be diminished as much as 30 per cent. by flood water, and again at low water the efficiency of such a plant suffers in spite of modern improvements. It would seem, however, that Marc Sangey, manager of the power station at Chevres, near Geneva, has hit upon a practical remedy for the first-mentioned trouble. His method consists in constructing two sluice gates in the foot of the weir. At flood times the large volume of water discharged through these sluices produces an ejector effect, whereby the water-level in that part of the tail race between the two sluices is lowered, and the turbine receives the benefit thus obtained. Experiments have proved that the ejector action or suction caused by the outflow from these sluices at high water is sufficient to maintain the water-level within the influenced area constant. Thus, instead of being allowed to flow aimlessly over the weir, the excess water in times of flood is used to counteract the drop in output which would otherwise ensue. At low water the sluice gates are kept closed, and all the head water then flows through the turbines in the ordinary way. The first practical experiments were made at the power station in Chevres. In this case the weir was provided with six underwater sluices. Between the third and the fifth of these, in front of the fourth closed sluice, the turbine was erected to receive the head water. At high water sluices 3 and 5 were opened wide, and caused by their ejector action a lowering of the water-level, as described, within the area of the tail races bounded by the two discharges. The natural head of water at the turbine was compared with the head thus obtained. It was found that the normal head was 4.96m., whereas with the underwater sluices 3 and 5 fully open, the head was increased to 5.80m. by the lowering of the level in the tail race—again of 1.11m. The turbine, which at high water gave an output of 1,233 horsepower with a volume of water of 26.6 cubic metres per second and the ejector sluices closed, proved capable with these sluices open of giving a maximum output of 1,543 horsepower, representing an increased efficiency of 23.6 per cent. The ejector sluices, it should be mentioned, discharged a volume of 205 cubic metres of water per second. Further experiments with a much lower head (1.7m. to 1.8m.) were made at the Vessy sur l'Arve power station, where a 1,200-horsepower turbine was similarly erected. In this case the turbine yielded an output of only 960 horsepower at high water with the ejector sluices closed, but gave its full output when they were open. It follows from these results that ejector sluices for the purpose in question, having a capacity of 150 to 200 cubic meters per second, are capable of counteracting the lost efficiency due to high water in a hydro-electric plant utilizing the natural fall of a river through the medium of a head-race and weir. A full account of these interesting experiments was published in the "Bulletin Technique de la Suisse Romande," issues 3 and 6, 1906.—"The Electrical Engineer" (London).

ADVANTAGE OF ROTARY CONVERTERS.

In a paper read before the British Institution of Electrical Engineers, Mr. Miles Walker said that it is not true that the motor-converter has all the advantages of a motor-generator, and as high an efficiency as the rotary. In comparing the efficiencies of different machines, it is very important to consider the basis of their ratings. When a substation is supplying a town load, it is always necessary to have enough machines running to avoid catastrophe in the case of sudden unexpected demands. The efficiency of the substation will greatly depend upon how many machines are running, and how near to full load they are working. If the station is provided with rotary converters, it is in most cases perfectly safe to have all the rotary converters fully loaded and allow them to be overloaded before a new machine is thrown in. When dealing with motor-converters or motor-generators, which are not able to take such excessive overloads without danger, the station engineer is not justified in normally running his machines up to such a high point. He must, except for the very steadiest loads, always have some capacity in hand to meet sudden demands and give him time to throw in other machines.

FIRST INTERNATIONAL EXPOSITION OF SAFETY DEVICES.

Space is now being assigned for the exhibits at the First International Exposition of Safety Devices, to be held in New York at the American Museum of Natural History beginning January 29, 1907, and continuing two weeks. Safety devices will be exhibited applicable to machinery used in various industries and in railway operation as well as for protection from fire. Since the object of this exposition is to awaken the American public to the necessity of doing something to lessen the accidents to life and labor, by means of a permanent museum of safety devices where all problems of safe-guarding life and limb can be studied in their working details, there will be no charge for space. It is earnestly desired that all those wishing to exhibit should apply without delay to the Director, W. H. Tolman, 287 Fourth Ave., New York.

IMPROVEMENT OF RIVERS AND HARBORS.

P. J. van Loben Sels, who attended the National Rivers and Harbors Congress held in Washington, D. C., in December, as a delegate from the River Improvement and Drainage Association of California, gives many important facts in his report to Rufus P. Jennings, President of the Association, regarding the meeting and the work that was done looking toward the betterment of conditions in California. Mr. van Loben Sels was requested by President Roosevelt to make known his ideas in writing relating to the proper methods of looking after the harbors and rivers of the country. The President promised to take the matter up with his cabinet.

Secretary of War Taft was especially interested in the work on the Pacific Coast, and had a long conversation with Mr. van Loben Sels regarding what was being done. In the Congress the resolutions adopted were confined entirely to the idea of having an annual appropriation of $50,000,000 made for the betterment of the waterways of the nation, as it was believed that such a policy would be far better than the old method of having the work parcelled out according to the influence of legislators from various sections.

It was along these same lines that the Counties Committee of the California Promotion Committee, at its recent meeting in San Diego, worked, believing that the ideas of a body of men like that assembled in Washington represented the consensus of opinion of those who had made a continuous study of the improvements of water ways.

In closing his report, Mr. van Loben Sels expresses himself as well pleased with the results obtained from the Congress, and says he thinks much good will come from the work done.

THE INSTALLATION OF ALTERNATING-CURRENT GENERATORS.

Engineers in charge of power stations and students of electrical engineering will no doubt be interested in the methods for installing alternating-current generators which are recommended and pract'ced by the Allis-Chalmers Company.

All of the generators built by this company belong to the revolving-field class, the armatures being fastened to the stationary frame. They are made in five types designated as "belted," "water-wheel," "engine," "fly-wheel," and "turbo," the last named being for direct-connection to steam turbines.

The mechanical construction varies to some extent with the size and type of generator, so that it is not practicable to give a description that will apply to all of these machines. In most cases, however, the general arrangement is as shown in Fig. 1. The manner of arranging the coils and interconnecting them varies with the number of phases for which the machine is built, the voltage, and other factors. Fig. 2 shows a portion of the winding for a three-phase machine with coils arranged the same as in Fig. 1. For lower voltage machines where it is not necessary to have such high insulation, the winding is frequently of the type shown in Fig. 3. All the coils are of the same shape and each side occupies only half a slot, one side lying in the upper part of one slot and the other occupying the lower part of another slot. The

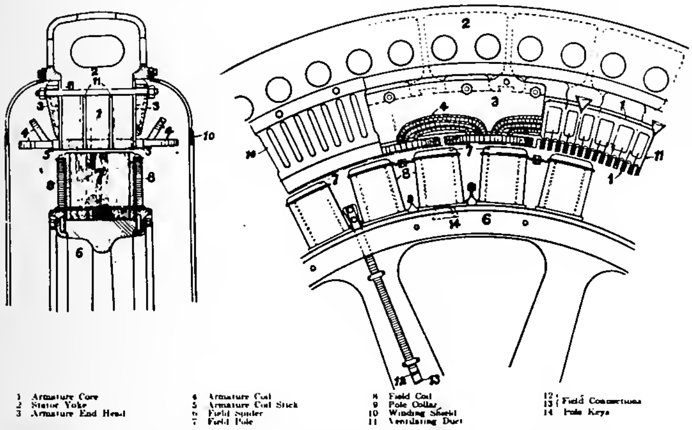
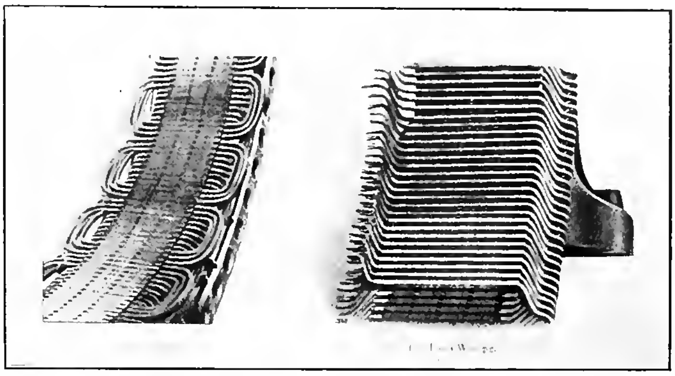


FIG. 1. CONSTRUCTION DETAILS OF AN ALTERNATING GENERATOR.

field coils of all except some of the smaller machines consist of bare copper strips wound on edge, with adjacent turns separated by tough insulating paper. In many small machines it is necessary to wind the field coils with square copper wire in order to admit of excitation at 120 volts.

The location of the generator is usually fixed beforehand by the position it must occupy relative to the engine or shafting. There is, therefore, little choice as to this, but it is always desirable to install alternators, or in fact any electrical machinery, in a clean, dry place where there will be plenty of light and room. Good ventilation is important, since the better the ventilation the lower will be the operating temperatures of the machine. There should not be any combustible material near the alternator and the location should provide for sufficent head room to permit taking the machine apart if necessary.

The foundation on which an alternator rests should be firm and substantial, in order to prevent vibration and secure smooth running. Small belted machines below 100 kilowatts can, if necessary, be set on heavy timber supports, but a concrete or brick foundation is preferable. All machines above 100 kilowatts should be provided with concrete, brick or masonry foundation, concrete being the most suitable. A satisfactory concrete for this purpose can be made of two



ALTERNATOR ARMATURE WINDINGS.

parts of sharp sand, four to five parts of broken stone and one part of Portland cement, all parts being by bulk.

The foundation should be heavy enough to secure freedom from vibration, and, in building it, provision should be made for foundation bolts to hold down the base, rails, or sole plates of the machines. In making the foundation, iron pipes should be placed in the approximate locations that the foundation bolts will occupy, using pipe having an inside diameter at least two inches larger than the foundation bolts, to allow adjustment. Pockets should also be arranged in the foundation to give access to the anchor plates and bottom nuts on the foundation bolts. After the alternator has been permanently located, thin cement should be run into the pipes, thus fixing the bolts accurately in position. Foundation bolts should be located by templates made from outline prints of the machine. The top of the foundation should be leveled off as accurately as possible and the cement allowed sufficient time to set before the machine is placed in position.

The National Board of Fire Underwriters favors the insulation of generators from the ground wherever it is feasible. Such insulation is generally provided by a substantial wooden frame or wooden stringers under the rails, the wood being well filled and varnished to prevent absorption of moisture. This is practicable with small belted generators, but with heavy machines or those direct connected to steam engines or water-wheels complete insulation from the ground is practically impossible; and it is better to connect the frame to the earth by means of a heavy copper wire connecting with a water pipe or other convenient ground. The frame of a machine should either be thoroughly insulated or thoroughly grounded so that there will be no doubt about its condition.

With belted machines, static electricity is frequently generated by the belt, thus charging the frame of the machine if the latter is thoroughly insulated from the ground. This

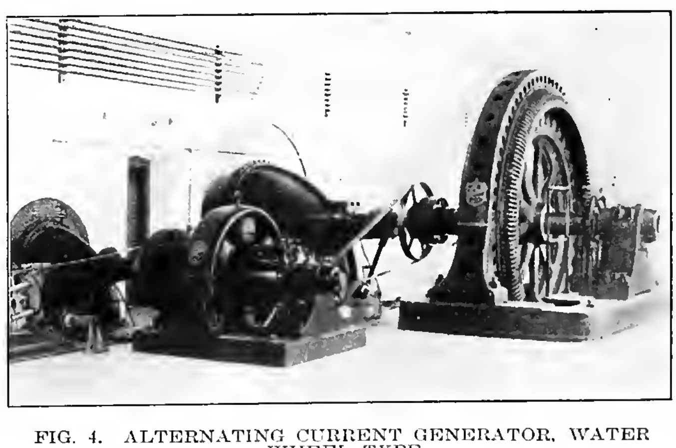


FIG. 4. ALTERNATING CURRENT GENERATOR, WATER WHEEL TYPE.

static electricty is generally removed by arranging a comb or a series of metal points close under the belt and grounding them.

The generators should be thoroughly protected against lightning and high potentials due to static electricity. The lines should be equipped with lightning arresters and, in cases where high potential static electricity is liable to accumulate, dischargers should be provided to carry it off.

Setting Up Belted Machines.

The rails should be placed in position, approximately leveled, and wedged up so that the weight of the machine will be distributed evenly. If the alternator is small and comes completely assembled, it can now be set on the rails, carefully leveled, and lined up with the driving pulley. If, however, the machine is of large size and shipped in two or more parts, the base is placed on the rails and the stator set in position, first making sure that the planed surfaces on the base and feet of stator are perfectly clean and oiled to prevent rust. Most of the larger belted machines are arranged so that the stator can be shifted to one side to give access to the field and armature coils, and when the stator is first set on the base it is advisable to locate it so that it will be to one side of the field when the latter is in position. All bearing surfaces should be well cleaned before the shaft is placed in the bearings; if there are any rough or rusty spots on the journals, they should be removed with crocus cloth. After the oil wells are inspected to see that they are thoroughly clean, the rotor is placed in position and the oil rings carefully watched to see that they do not get jammed and bent out of shape. When the rotor has been placed, the caps of the bearing pedestals are put in position and bolted down firmly. The stator can now be slid into place over the rotor and also bolted. If there are any dowel pins in the feet of the stator, they should be in position before the cap bolts are screwed down. The bearings are next filled with a good quality of mineral oil to the proper height as indicated by the oil gauge.

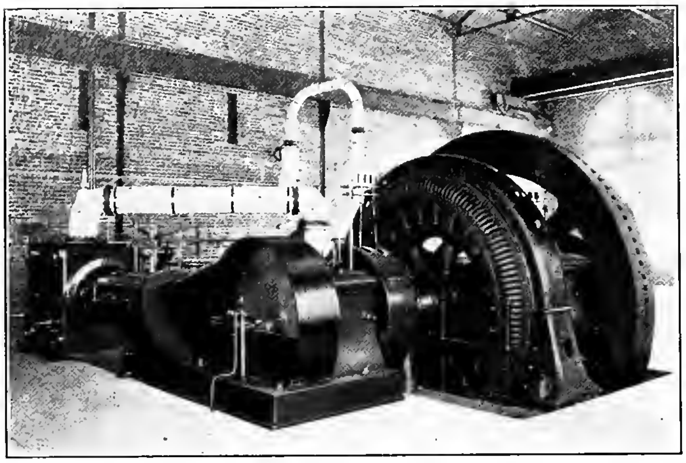


FIG. 5. ALTERNATING CURRENT GENERATOR DIRECT-CONNECTED TO A CROSS-COMPOUND HEAVY DUTY ENGINE.

The pulley is now keyed to the shaft, and the whole machine lined up with the driving pulley. If possible, the machine should be run with a rather slack belt while the alignment is adjusted until the belt runs on the center of the pulley and allows the rotor to oscillate freely in its bearings.

Finally the foundation bolts are tightened down and the rails "grouted" by making a thin, easy-flowing mixture of one part of Portland cement and one part of sand, together with sufficient water, and pouring it under and around the rails. Small clay dams can be used to keep the thin cement in place until it hardens. When the cement is partly set the surplus can be removed and the joint under the rails smoothed up.

Water-wheel Type Machines.

The foregoing directions regarding belted machines apply for the most part to water-wheel alternators also, except that the latter have no rails, and the base is set directly on the foundation. In this case the machine must be lined up accurately with reference to the water-wheel so that the halves of the flange coupling will fit exactly. After lining up by means of wedges under the base, the foundation bolts should be tightened and the base well grouted in. Plenty of wedges should be placed under both inside and outside edges of the base so as to give a firm and even support. In some cases where water-wheel alternators are of large diameter and run at low speed, no base is provided. The stator and bearing pedestals rest on sole plates bolted to the foundation in the same manner as will be described for engine-type alternators.

Engine-type Machines.

With engine-type alternators the stator yoke either rests on an extension of the engine bed, as with some of the smaller machines coupled to high-speed engines, or on sole plates set on suitable foundations. The stator sole plates are made in two parts, the lower one being bolted to the foundation, while the upper plate is adjustable to facilitate centering the stator with respect to the field. To set up the machine, proceed as follows:

Locate the sole plates temporarily in position and support them on iron wedges to allow for further adjustment. Place the lower half of the stator in position and level it approximately by means of the leveling screws in the upper part of the sole plate. In case the stator is arranged to shift sideways on the base or sole plates, set the stator to one side so that it will be away from the rotor when the latter is placed in position. Locate the revolving field and engine shaft in the bearings, observing the same precautions given under belted machines. In case the engine shaft has not been pressed into the rotor spider at the factory, and it is necessary to do this work on the ground, special instructions should be sent, and the work done by an expert machinist.

Place the top half of the yoke in position, first making sure that all planed surfaces are perfectly clean. Carefully center the stator with respect to the field by means of the adjusting screws in the feet and sole plates, and measure the air-gap between stator face and sole pieces at a number of points around the circumference; it is very important to have the air-gap uniform, as otherwise the frame will be subjected to an unbalanced magnetic pull causing bad operation.

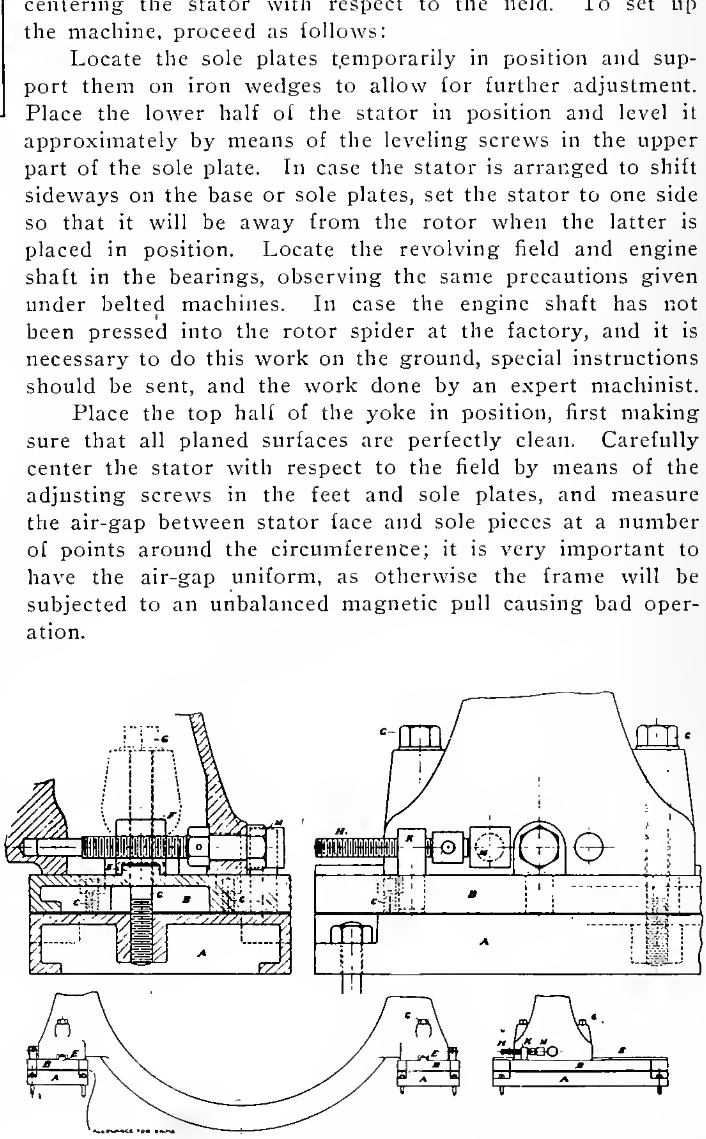


FIG. 6. ADJUSTABLE SOLE PLATE OF ALTERNATOR.

In large water-wheel and engine-type alternators where the stator is split, it is usually necessary for convenience in shipping, to disconnect and remove a few of the stator coils at the two partings in the frame. These must be carefully put in place and properly connected according to the instructions furnished with the generator. The coils must not be bruised and all connections should be neatly made and insulated to correspond with those for the other coils.

In aligning the yoke see that the center of the armature laminations is in line with the center of the pole laminations; if they are not in line there will be a side thrust on the shaft.

After the yoke has been finally adjusted insert shims between the upper and lower parts of sole plates so as to take the weight off the leveling screws. Drill and tap holes in the lower sole-plate to receive the holding-down bolts for the stator, and bolt the latter securely in place. Fig. 6 shows the construction of an adjustable sole-plate. A is the lower plate bolted to the foundation, B is the upper adjustable plate, CC are the leveling screws. The yoke is held in line by spline E; and by means of a bolt threaded into block F the yoke can be shifted in a direction at right angles to the shaft. For sliding the yoke sideways along the sole-plate, a jack screw H turns in nut K and bears against a plug M, which fits into a hole in the stator foot. Parts H, K and M are removed after the stator has been shifted to its final position.

Next grout in the sole-plates, and after the cement has set, tighten the foundation bolts and carefully check over the alignment of the machine. If at any time the engine bearings are adjusted or realigned the air-gap between stator and rotor should also be checked over and the stator again lined up, otherwise an uneven air-gap will result or the rotor may even rub on the stator.

With small alternators the collector rings are mounted in place on the shaft and connected to the field windings, while on large machines, especially of the engine-type where there is no shaft, the rings are shipped separately. In large machines both hub and rings are split so that they can be put in place after the rotor has been mounted in its bearings. The collector rings are fixed securely in position so as to run true, and the rings connected to leads from the field winding, making sure that all contacts are clean and tight.

With large engine-type alternators and also with some of the larger water-wheel machines, the brush holders are supported by a stand bolted to the base or to a bridge fastened to the sole-plates. On smaller machines the brush holder studs are supported by the bearing pedestals. All insulating bushings and washers on the brush studs should be looked over and the studs examined to see if they are bolted up tight. The brush holder stand, if there is one, should be firmly bolted to the bed or bridge and properly aligned with reference to the collector rings.

The brushes should be carefully fitted to the collector rings first by using coarse sand or garnet paper, and then by finishing with fine sandpaper. While shaping the brushes hold the paper well down on the rings so as not to wear away the edge of the brush. See that the whole surface of the brush makes contact with the ring and that the finger presses squarely on the brush. The pressure should be adjusted by changing the position of the tension spring on the arm, and should be such as to give a good contact on the ring; a greater pressure improves the contact very little and only causes excessive friction loss, wear, and heating of the brushes and rings. Good judgment and careful attention will soon show the best pressure to be used.

After the oil wells are filled to the proper height, the covers should be put in place so that no sand or dust can get into the bearings. When the machine is first started it is advisable to draw off the oil at the end of each day's run and fill up with fresh oil until it is certain that all fine particles of foreign matter have been removed. The oil drawn off can be filtered and used over again. When a machine is first started, it is well to run it slowly for about an hour and watch the bearings closely before bringing it up to full speed.

In all wiring, special attention should be paid to the mechanical execution of the work as extra precautions are necessary when wiring for high pressure alternators. The requirements of the National Board of Fire Underwriters should be carefully fulfilled, and care taken that all joints are secure and thoroughly insulated. All wires should be of sufficient cross section to carry at least 25 per cent overload without over-heating. For wires larger than Nos. 2, B. & S., it is advisable to use stranded cable, as this is much easier to run than solid wire.

DANGER OF POISONING FROM SUCTION GAS.

Captain Sankey, who copiled the report on tests of suction gas plants carried out by the Royal Agricultural Society of England, stated that the chances of poisoning were carefully considered, since the gas produced contains a large amount of carbonic oxide, which is of a very poisonous nature, and being inorodorus may easily escape detection. When an engine is working the pressure in the producer is below that of the atmosphere, and therefore any leakage would be into the producer. Hence the only real danger is when the producer is being started or opened up after running, and an accident can only occur through gross carelessness. When the producer is being started there is a pressure in it due to the fan; and to reduce the effort of blowing, and get rid of the air in the pipes, etc., a large vent pipe is opened by means of a valve. The outlet of this pipe should be carried outside the building where the discharge of gas can do no harm.

THE ARTIFICIAL DISPERSION OF FOGS BY ELECTRICITY.

The problem of artificially dispersing fogs has been studied by Maurice Dibos for some years past. As long ago as 1899 he endeavored to accomplish this by means of compressed air discharged from the bow of a steamer. Still later he took up the electrical method, using both alternating and direct currents, and succeeded in clearing zones from 100 to 150 metres in diameter. As soon as the discharge was stopped the fog at once closed in again, but dispersed upon renewing the discharges. Although what has been done in this direction is small, it points to possible important developments which would be particularly valuable in important commercial points. The article gives a review of all the work that has been done upon this problem, and gives some data showing the amount and kind of solid matter found in the air of certain large cities.—Abstract from "L'Electricien," by the "Electrical Review," (N. Y.)

WIRELESS TELEPHONY.

A practical test of wireless telephony was made recently at Cologne. The receiving apparatus was placed close to the bank of the Rhine, and messages were transmitted across the stream, it is said, with success. The transmitting and speaking apparatus, with a battery of 20 cells, was connected with a copper wire, the end—attached to a zinc plate—being sunk to the bed of the river. The Rhine served as the conductor, and the receiving device reproduced the sounds, enabling persons to converse with others on the opposite bank of the stream. Experiments were made over a distance of three miles, and while sounds were received from a greater distance, it was not possible to distinguish the words clearly. It is believed that wireless telephony will be of great use for shipping and harbor traffic.—"The Electrical Magazine."

AUXILIARY STEAM PLANT OF THE MOUNT WHITNEY POWER COMPANY.

In the Fall of 1905 the Mount Whitney Power Company decided to build an auxiliary plant near the city of Visalia to be run in conjunction with the water power plant already in operation. A careful investigation was made of the relative merits, costs and economies of gas engine, steam engine and steam turbine power plants, and resulted in the selection of the steam-turbine as the prime mover best suited to the local conditions. The new plant is situated just beyond the city limits. A spur track of the Southern Pacific Railroad runs through the property, and, therefore, it was possible to deliver the machinery without additional hauling. Fuel oil cars will be switched on this siding, which can accommodate six cars at one time.

The main unit consists of a Westinghouse-Parsons 1,000 kilowatt steam turbine, direct connected to a three-phase, 60-cycle, 2,300-volt generator, which has a continuous overload capacity of 25 per cent. The foundation for the turbine is made up of two parallel concrete walls spanned across the top by suitable I-beams. Between these I-beams and the turbine bedplate, there is a layer of lead about one inch thick. Since the centre of gravity of the Westinghouse-Parsons turbine is low, and there are no reciprocating parts, no foundation bolts are required.

The exciter set consists of a 17½-kilowatt Westinghouse, 125-volt engine type generator, direct connected to an Ohmen vertical engine. The switchboard is divided into generator, exciter, totalizing, transformer, and distributing panels. All main switches and bus bars are beneath the turbine room floor, and no high tension wiring is carried to the switchboard.

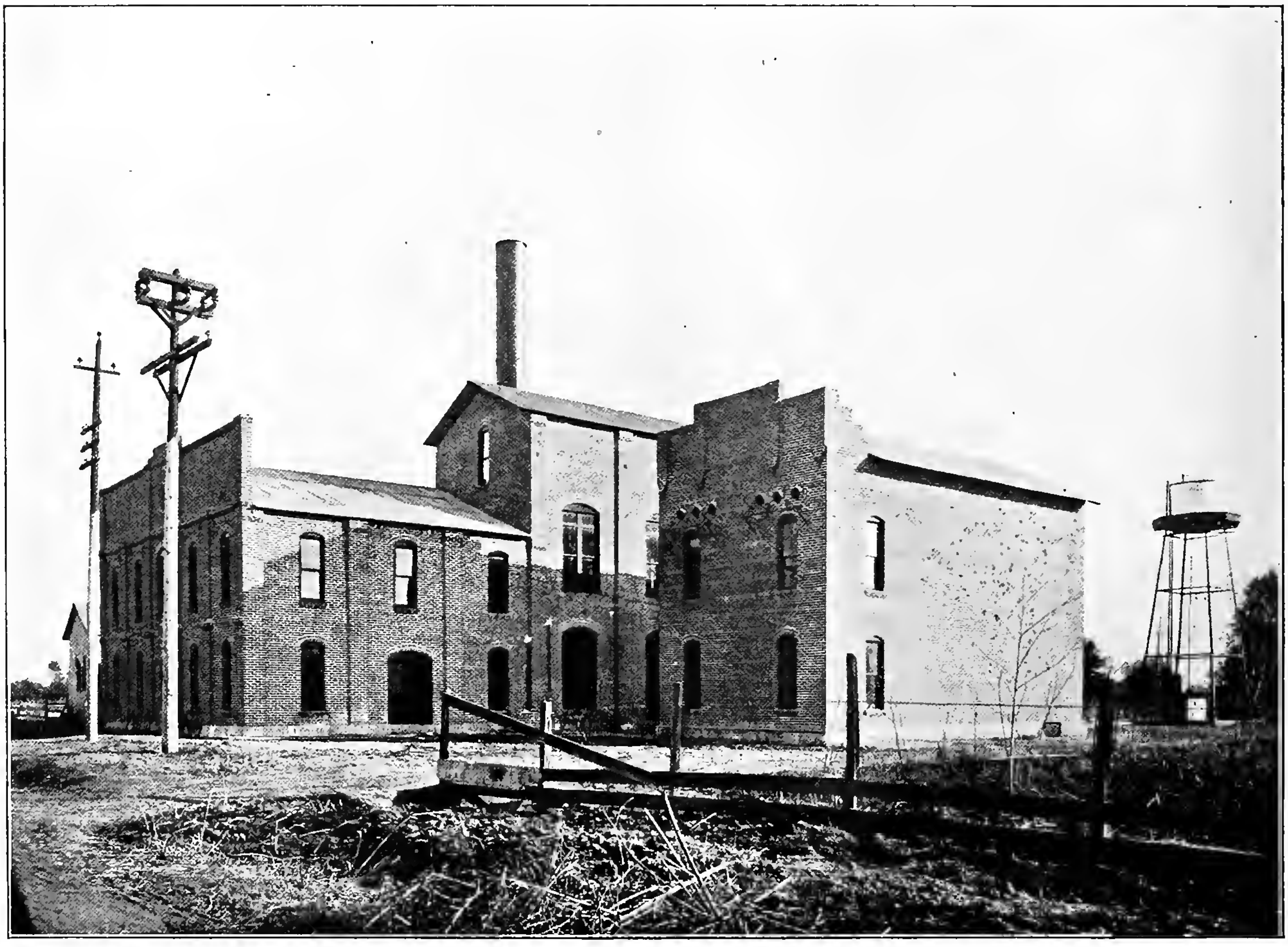


FIG. 1. BUILDINGS OF THE MT. WHITNEY POWER CO.

The buildings consist of a main power house, a high tension transformer house, and a store house. The power house is a substantial brick building with steel roof trusses and a galvanized iron roof. The front portion of the building has two floors. On the first floor are located the shop and store rooms, and on the second are two bed rooms for the operators, a large bath and lavatories, a commodious reading room for employes, a testing laboratory, and the chief engineer's office. The power house proper is practically one large room, there being no partition between boilers and machinery. Figures 2 and 3 show a sectional elevation and plan of the power house, and indicate the compact arrangement of the equipment. The boiler room and the basement of the engine room are on the same level. This arrangement affords ample light and good ventilation, and simplifies operating conditions.

Stirling water tube boilers were adopted on account of their quick steaming properties, great overload capacity, small cost of maintenance, and the short time required to clean and reconnect them for service. There are three boilers, two set in battery and one in half battery. These boilers are constructed for 200 lbs. working pressure, and each contains 3,030 square feet of heating surface. The condensing equipment, furnished by Henry R. Worthington, is immediately under the turbine and between the foundation walls. It is of the surface type, containing 3,600 square feet of effective cooling surface, and is fitted with inner air cooler and hot-well. The condensed water drains into the condenser hot-well, and is removed by a two-stage Worthington pump driven by a 5 horsepower direct connected induction motor.

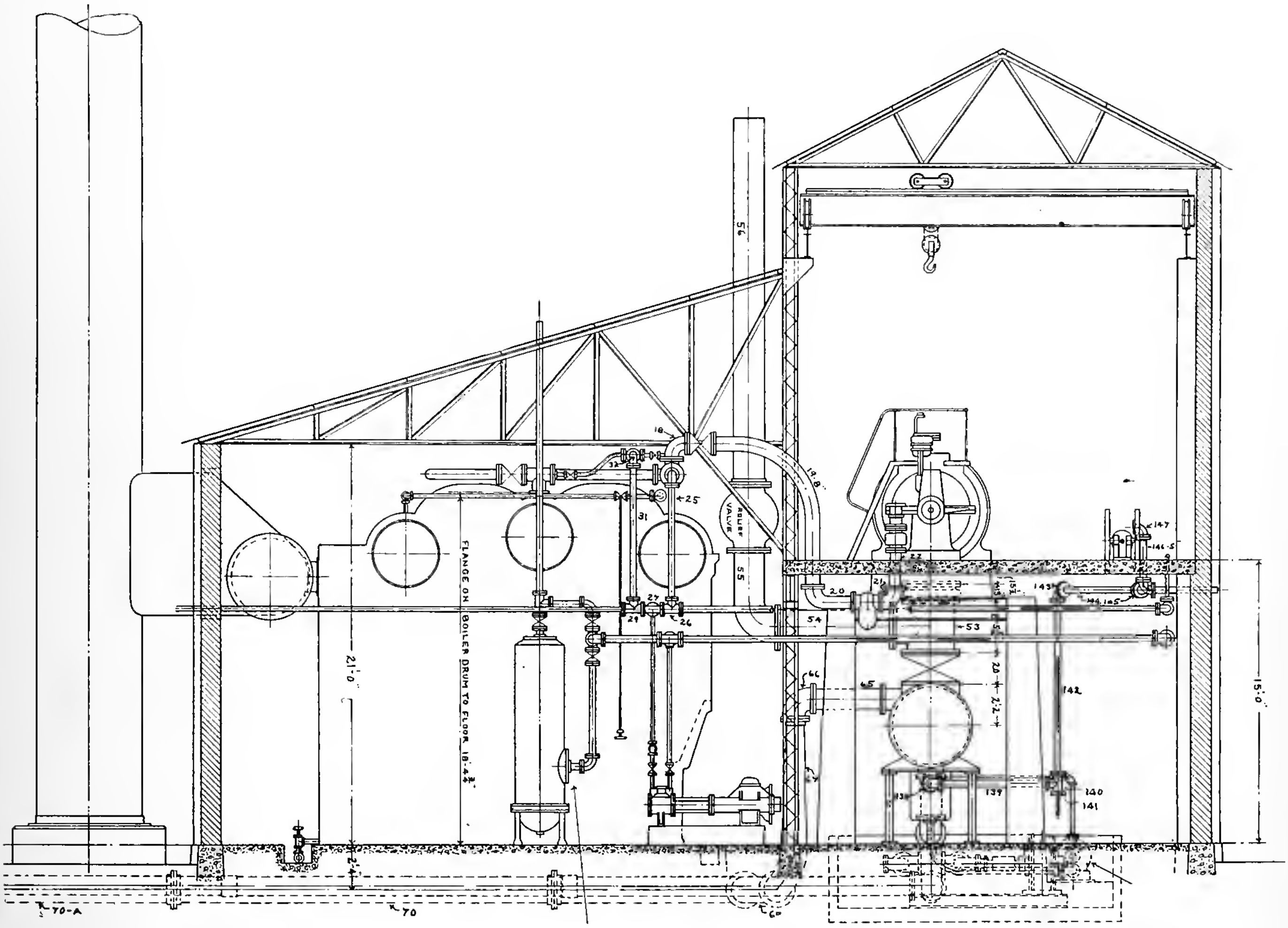


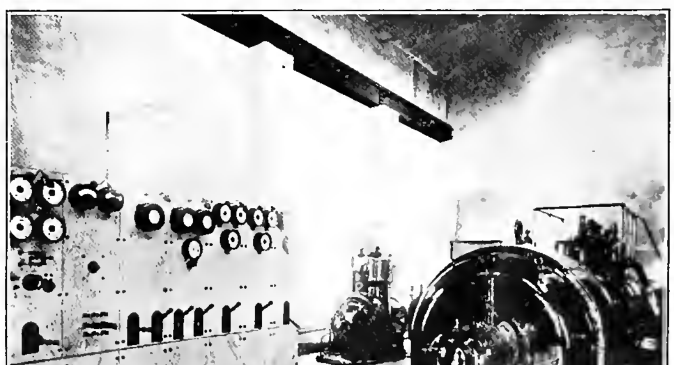
FIG. 2. SECTIONAL ELEVATION OF POWER HOUSE, MT. WHITNEY POWER CO.

The air and non-condensable vapors are removed by a direct acting steam driven dry vacuum pump located on the turbine floor. The suction and discharge valves are mechanically operated, and the clearances are reduced to a minimum. A 12-inch circulating pump of the centrifugal type is direct connected to a 50-horsepower induction motor.

As the water supply is derived from wells, it was necessary to install a cooling tower. This consists of a concrete pit, in which is mounted a suitable wooden framework which supports layers of fine galvanized iron wire cloth. The tower is divided into sections 48 inches wide and 20 inches across. The circulating water is discharged from the condenser into a main distributing box on top of the cooling tower. Lateral troughs are carried the full width of the tower, and the water is distributed to each section through openings in the walls of these troughs.

The make up water for the system is taken from a bored well by a 6-inch centrifugal pump, direct connected to a 10-horsepower induction motor. This pump discharges directly into the suction of a 12-inch circulating pump, the main circulating water being drawn from the cooling tower pit. The boiler feed pumps are of the Worthington type, 10½ by 5 by 10 inches. The fuel oil pumping system consists of two 4½ by 2¾ by 4 inch piston pattern pumps mounted on a cast iron tray, with heater, gauges and relief valve.

All steam-driven auxiliaries exhaust into a 1,000-horsepower Patterson-Berryman closed feed water heater, which raises the temperature of the water to 205 degs. Fahrenheit, and are built to take steam at boiler pressure (200 lbs.), thus eliminating the use of reducing valves, which are always a source of annoyance. The piping, valves and fittings subjected to boiler pressure are extra heavy and built to withstand a working pressure of 250 pounds. All live steam piping is insulated with an 85 per cent magnesia covering. The question of economizers and superheaters was carefully considered, and after estimates had been made of the saving under the probable operating conditions of the plant, they were considered a doubtful investment and were not installed. The step-up transformers, protective apparatus and high tension switches are located in a separate building; the transformers and lightning arresters are located on the ground



SWITCHBOARD AND EXCITER SET, MT. WHITNEY POWER COMPANY.

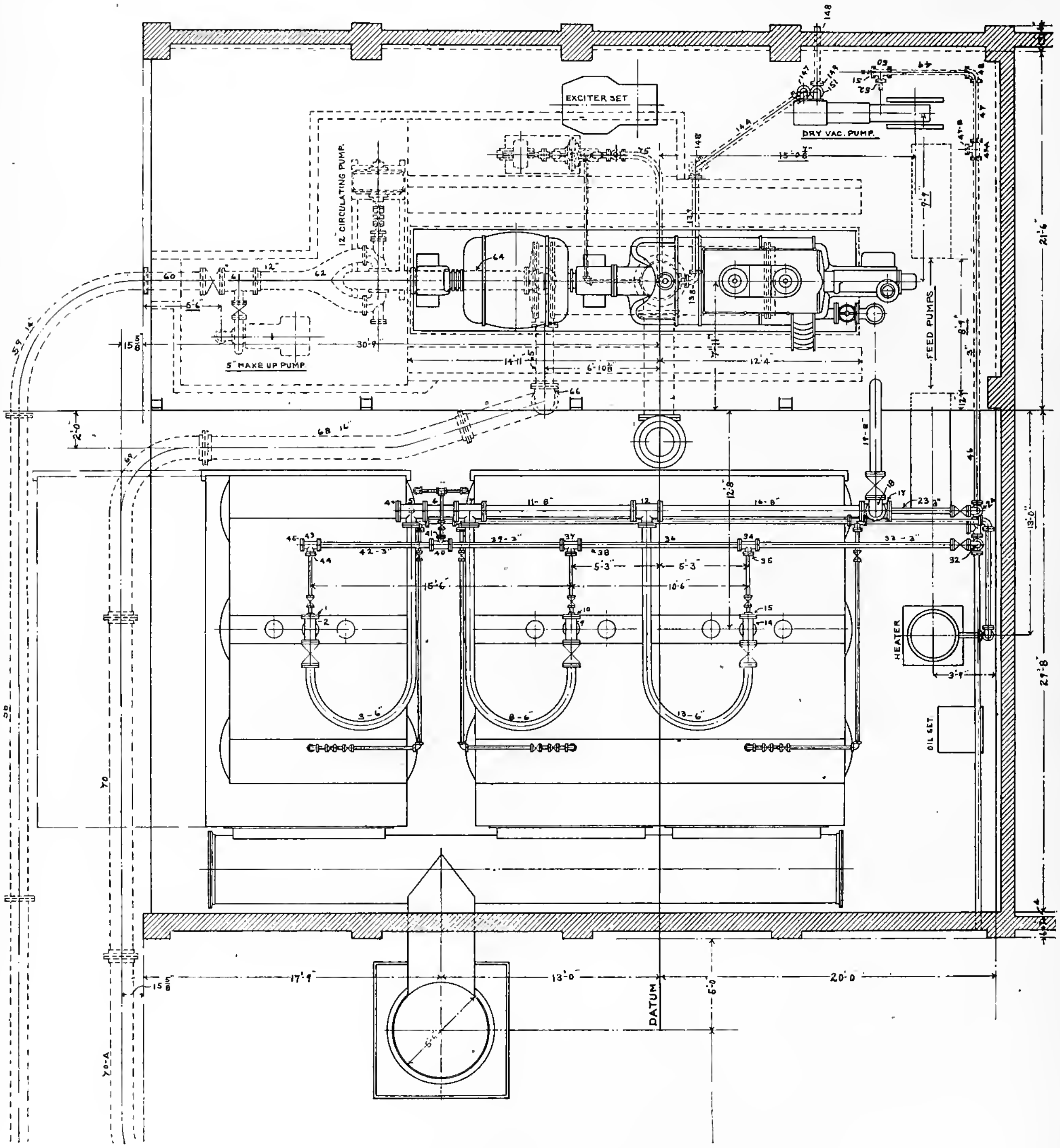


FIG. 3. PLAN OF POWER HOUSE, MT. WHITNEY POWER CO.

floor, and the high tension switches on the floor above. There are four 375-kilowatt oil insulated transformers of which the high tension coils may be connected for either 15,000 or 30,000 volts.

The external method of cooling the oil is used, and a single cooling coil is located outside of the transformer house. The oil pumped from the transformers through the cooling coil and returned again. The amount of water required for cooling can be regulated according to the load on the transformers, and during heavy overloads the temperature can be kept down to normal full load guarantees. This method of cooling is considered superior to the ordinary method of using internal cooling coils, in that, if any leakage takes place it is external instead of internal, as the pressure in the oil is greater than the water pressure.

The 2,300-volt leads from the switchboard consist of lead covered cables carried in tile ducts. Switches are so arranged on both the low and high tension sides that any transformer may be cut out of service, and the spare transformer switched in without loss of time.

This plant was completed in August, 1906, and has been operated since that time only as the necessities of the water power plant demanded, and to familiarize the operators with it. It has proven very satisfactory in every way, and synchronizes readily with the water power station.

The entire plant was installed for the company by Hunt, Mirk & Co., Inc., who acted as purchasing agents, and designing and supervising engineers. The work was carried out on a cost plus a percentage basis, which plan was found advantageous, and very satisfactory to the company. The running tests were made by taking the kilowatt-hour output of the station per barrel of fuel oil burned, and showed material increase in efficiency over that calculated when the plant was designed. For the information contained in this article we are indebted to Mr. C. H. Holley, who is chief engineer for the Mount Whitney Power Company.

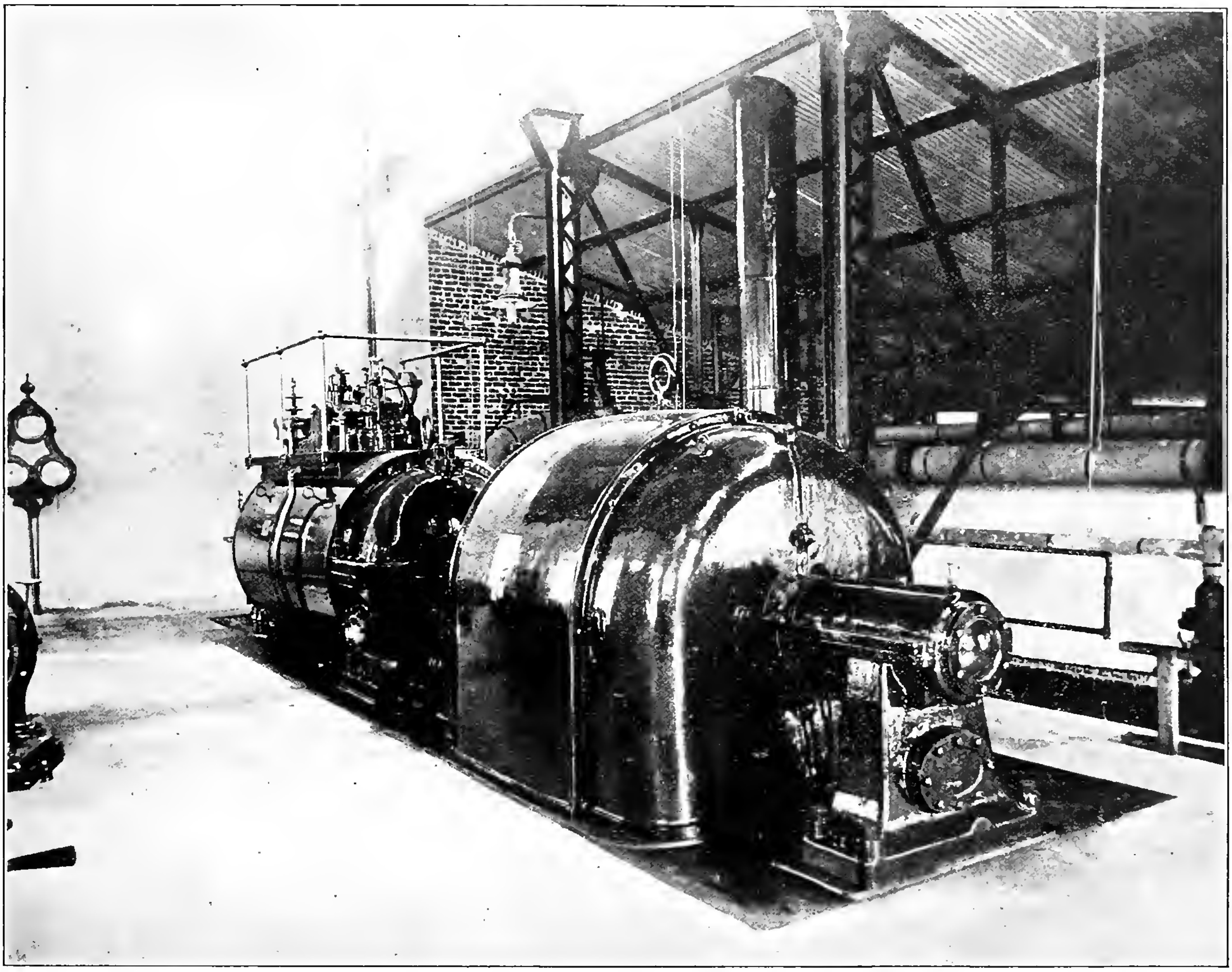


FIG. 4. 1000-KILOWATT WESTINGHOUSE-PARSONS STEAM TURBINE AND GENERATOR, MT. WHITNEY POWER CO.

MINERAL PRODUCTS OF THE UNITED STATES.

The mineral products of the United States for the calendar year 1905 amounted to a total value of $1,623,877,127, according to the report of the United States Geological Survey, issued in November, 1906. In 1904 the value was $1,360,-883,554. The production of pig iron in 1904 was 16,497,033 tons, with a value of $233,025,000. In 1905 this production amounted to 22,992,380 tons with a value of $382,450,000. The production of copper was 812,537,267 pounds in 1904, with a value of $105,629,845, and in 1905, 901,907,843 pounds, valued at $139,795,716. Of aluminum, the production in 1904 was 8,600,000 pounds, with a value of $2,477,000; in 1905, 11,347,-000 pounds were produced, valued at $3,246,300. The production of platinum for 1904 was 200 ounces, value, $4,160; in 1905, 318 ounces were produced, with a value of $5,320. Of the non-metallic minerals, 668,538 pounds of sheet mica, with a value of $109,462, were produced in 1904, and 851,800 pounds were produced in 1905, having a value of $185,900. Of the metal tungsten, which is grouped with unspecified mineral products, the value of $268,676 is given to the production for 1905.

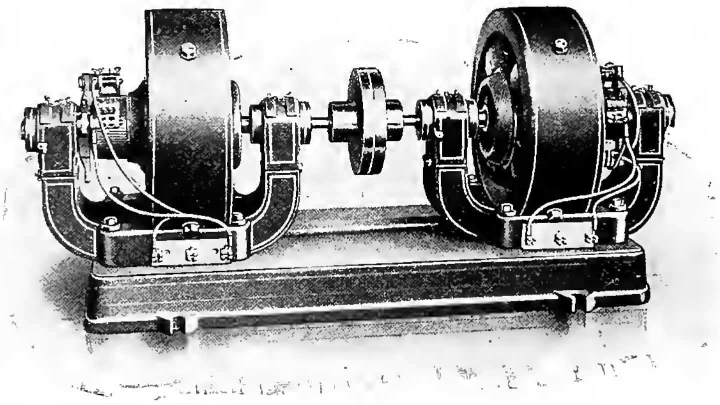
WIRELESS TELEGRAPHY AND TRAWLING.

A novel use for wireless telegraphy has been found in America. One of the large fishing fleets has adopted wireless telegraphy as a means of keeping track of the shoals of fish that haunt the Atlantic coast. The Fisheries Company controls a herring fishing industry of the coast, operating from Maine to Charleston, S. C., having factories centrally located at different points along the coast. It possesses a fleet of forty steamers, and its object in adopting wireless is to get in closer touch with the fish as they traverse the Atlantic seaboard, as well as keeping in touch with its steamers from the shore. It will arrange to communicate with coastwise steamships equipped with wireless, and in this way learn of the movements of fish that may be sighted by these coasting steamships. It will also be in position to use wireless to advantage in keeping its fleet posted. Thus part of its fleet may be near Sandy Hook cruising for fish, while the other part may be off Virginia, and in the event of their finding fish at either point they could at the moment notify each other and all assemble without delay to the location where the fish are being caught. If the above installations prove satisfactory, the Fisheries Company propose to install wireless on the remainder of its fleet. Six steam vessels have now been equipped with the De Forest system.—"The Electrical Engineer" (London).

INDUSTRIAL

ROTH ELECTRICAL MACHINERY.

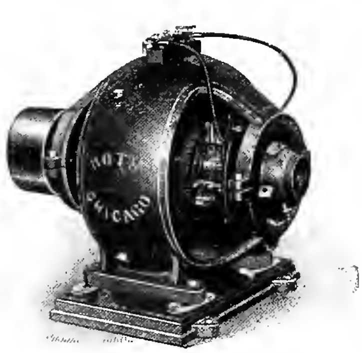
Of the power developing contrivances which engineering skill has thus far been able to put forth, electro-magnetic machines have undoubtedly reached the highest state of nerfection. The demand for this class of machinery is so great and competition is so keen, that the successful manufacturer must not only embody in his machines those qualities which mean reliability, long life, economical running and



Roth Motor Generator

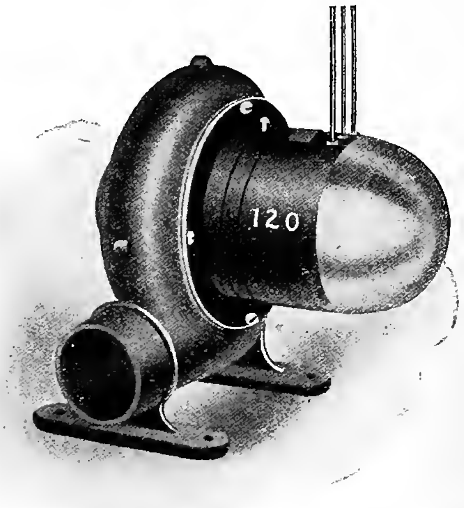
slight attention, but, in addition, special features which make his products compare favorably with those of other energetic concerns. Roth Bros. & Co., 27-29 South Clinton street, Chicago, are producing a class of machines adapted for general use in machine shops, laundries, bakeries, factories, grocery and candy stores, and other commercial establishments.

The motors may be either belted, or direct connected by couplings or gearing with shafts at an angle of 90 degrees, 45 degrees, or at any other angle desired When belting is used the motors may be suspended from the ceiling or wall, or fastened to the floor. Generally, both motors and dynamos are of the semi-enclosed type, but for dusty or exposed places cover plates are provided, which make the machines proof against moisture, dust and other objectionable matter.



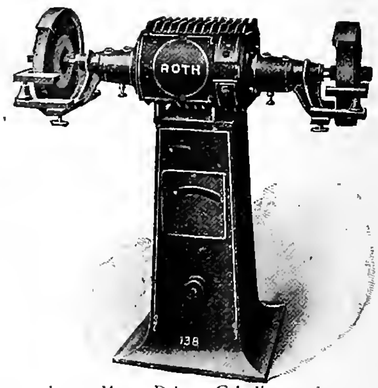
Roth Motor

Dynamos are built for lighting purposes with capacities for supplying circuits containing from 2 to 300 sixteen-candlepower lights, and are ordinarily wound for 110 and 220 volts. The motors are built in sizes ranging from one-sixteenth to twenty horsepower, and are furnished series, shunt or compound wound. There are many special forms, among them being the back-geared motor and the electrical countershaft for driving machine tools, the ringing generator for telephone work, vertical motors for driving electro-typing machinery, and many others.



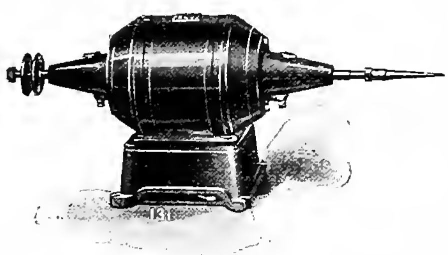
Electric Forge Blower

An extensive line of motor-dynamo sets is also manufactured by this firm. These are suitable for use on telegraph lines, for charging batteries, ringing call bells, operating signals, magnetizing coils, electroplating, electrotyping, and as boosters, equalizers, etc.



Large Motor Driven Grinding and Polishing Machine

The electric forge blower, as shown in the illustration, is a unique combination of motor and blower which can hardly be excelled for compactness and convenience. A mere turn of the starting box lever produces a steady blast of air on the fire and relieves the blacksmith from trying to do two things at one time, which is necessary in the old way. These blowers are constructed for both heavy and light work and for use on both alternating and direct current circuits.



Grinding and Polishing Machine for Bench Work

Considerable attention is devoted by this firm to the manufacture of motor-driven grinding and polishing machines. The larger machines are mounted on cast-iron stands which may be fastened to the floor. A very important feature is the large working radius, which enables the operator to grind and polish long pieces with the face of the wheel and not with the corners. This is made possible by giving the magneto-frame a peculiar shape. The poles are steel castings of round cross-section and therefore permit the use of circular coils which are the most efficient.

Two hand holes are bored in the frame to give access to the brushes and commutator and two peep holes are pro-

vided so as to avoid the necessity of removing the hands to see inside of the machine.

By means of a speed regulator it is possible to obtain the speed best adapted to the work in hand by the simple movement of a lever.

Small grinding and polishing machines are also made for light work. These are not fitted to high stands, but are mounted on low bases for bench work.

ELECTRIC SOLDERING TOOLS.

The Vulcan Electric Heating Company, of Chicago, is publishing in our advertising pages of this issue an invitation for all Pacific Coast visitors at the Chicago Electrical Show, January 14th to 26th inclusive, to call at its exhibit, space 14, at the left of the main entrance, where high temperature electric soldering and branding appliances will be shown in full operation and the practicability and superiority of electrically heated tools clearly demonstrated.

Although electric soldering tools have been on the market for a number of years and have been tested many times, the results have, until recently, been quite unsatisfactory, and the majority of possible users have been of the opinion that satisfaction and economy could not be depended upon in the use of these tools.

The Vulcan Electric Heating Company now comes forward with the offer to guarantee satisfaction; its confidence being based on the behavior of thousands of these tools sold during the year 1906, many of them to large plants in which economy is a very important item, where the tools were thoroughly tested and adopted only on the strength of economical operation and improved results.

It is, therefore, an item of great interest to those engaged in soldering and branding operations, that the above mentioned company proposes to exhibit at Chicago a line of thoroughly satisfactory electrically heated tools, in connection with instruments which will register the current consumption, enabling the visitors to figure the actual cost of operation and make actual tests of working efficiency.

The claim is made that these tools will be shown to be superior to the gas-heated article in economy, convenience and reliability, and that they will be found thoroughly practical in service.

While it is presumed that many interested parties here on the Coast will be unable to see this demonstration, it is hoped that those who do attend the Chicago Electrical Show in January will take advantage of this opportunity.

What we want here on the Coast is the best that can be procured and operated with the greatest possible economy. It goes without saying that the electrically heated tool will eventually supersede the cruder arrangements, and we sincerely hope that the Vulcan Company's efforts to introduce them will succeed.

We have been informed that the Vulcan Electric Heating Co. will open a vigorous selling campaign on the Coast, through the various dealers, central stations and contractors. The company has the reputation of standing behind the quality of its product and making good all faults.

A red hot branding tool will be operated in branding souvenirs for visitors. A large electric soldering tool running a continuous seam, satisfactory electric soldering tools, solder pots, wax pots, etc., will also be exhibited. It is hoped that some of our engineers and practical men will investigate these appliances and report their opinions.

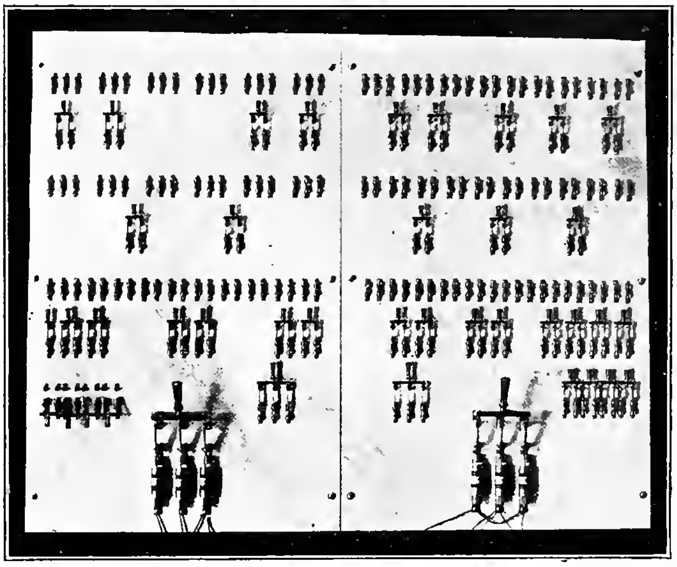
A NEW PLANT.

The Geo. E. Dow Pumping Engine Company, which suffered severely in the April fire, succeeded in re-establishing itself on a large basis, and during the past four months has kept its works in full operation. The present location of the works is on the old site, which constitutes the block bounded by First, Howard, Fremont and Natoma streets. This is, however, only temporary, as the company is planning to build a permanent plant on ten acres of land lying on the Alameda side of the Tidal Canal. The iron foundry will be 150 by 450 feet, and the main machine shop 150x600 feet. The company will generate electric power in a station to be equipped with machinery of its own manufacture, with the exception of the generators.

The new plant is being designed with an eye to obtaining a maximum efficiency, and will be one of the most complete plants of its kind in the West. As a sign of present progress, the company reports having double the work on hand that it had previous to the fire, which is a significant example of the fact that it pays to specialize in manufacturing.

PROGRESS OF A SAN FRANCISCO FIRM.

The Bay Shore Electrical Construction Company, 186 Second street, announces that its repair shop has now reached a standard which entitles it to be classed with the best equipped shops on the Coast. It is particularly strong in facilities for rewinding armatures, a class of work on which



Switchboard recently constructed for the American Theatre, San Francisco, by the Bay Shore Electrical Construction Company.

this company has built up a reputation in San Francisco and neighboring towns and cities.

Aside from continuing its work in general electrical construction, this company is about to undertake the extensive manufacture of switchboards, panels, marine fittings and other electrical auxiliaries. Its stock of Barriett motors is now complete. Several sales of these, under the customary guarantee for one year, were recently reported.

NEW RECEPTACLE FOR INCANDESCENT LAMPS.

The Benjamin Electric Mfg. Co., of Chicago, are placing upon the market a new No. 6-B receptacle specially designed for use with outlet boxes. It has a number of strong, attractive features, among which may be mentioned the following: Its contacts do not project beyond the walls of the receptacle, and therefore do not readily come in contact with the metal parts of the box or projecting parts of the conduit; wires are easily spread around the base, thus making slack wire unnecessary; the binding screws are accessible from the front, thus obviating the necessity of reversing the receptacle or of tapping wires to make connections; it

may be connected while in position in the box, the cover being attached after electrical connections have been made.

A steel plate cover is furnished, together with a polished brass cover. Where desired a shade holder is spun upon the latter, thus forming a part of it. The result is a neat, substantial and serviceable article.

ELECTRICAL SHOW AT CHICAGO.

Chicago's second annual electrical show, which will be held in the Coliseum from January 14th to 26th, 1907, will be the banner trade booster of the United States. More than 30,000 square feet of the main floor of the Coliseum has been sold to one hundred and fifty of the leading manufacturers and jobbers of electrical supplies, many of whom will make displays for others as well as for themselves. Not a single branch of the electrical field will be overlooked, and the exhibits, as a whole, will be greater and more elaborate than they were in the show of a year ago. At this writing there are but five spaces left on the main floor, the complete list of exhibitors being as follows:

Armour Institute; American Steel & Wire Co.; American Telegraph & Telephone Co.; Automatic Electric Co.; Allis-Chalmers Co.; American Telephone Journal; Aetna Stage Lighting Co.; Anderson, Albert & J. M. Mfg. Co.; American Clock Co.; American Vibrator Co.; Antiseptic Co., The; American Electrical Novelty & Mfg. Co.; American Sewer Pipe Co.; American Electric Heater Co.; Burns, W. J.; Bryan-Marsh Co.; Bryant Zinc Co.; Brilliant Electric Co.; Bidwell Electric Co.; Beck Flaming Lamp Co.; Bishop Gutta Percha Co.; Baton Electrical Mfg. Co.; Bossert Electric Construction Co.; Crockett, W. P. Co.; Chicago Telephone Co.; Chicago Pneumatic Tool Co.; Cook, Frank B.; Cooper-Hewitt Electric Co.; Central Electric Mfg. Co.; Chicago Battery Co.; Chicago Edison Co.; Crane Co.; Central Electrical Co.; Chicago Lamp & Reflector Co.; Chicago Compound Battery Co.; Commonwealth Electric Co.; Crescent Wire & Cable Co.; Crawfordsville Wire & Nail Co.; Crescent Co.; Columbia Incandescent Lamp Co.; Colonial Electric Co.; Crouse-Hinds Co.; Dixon, Joseph, Crucible Co.; Dossert & Co.; Duncan Electric Mfg. Co.; Diehl Mfg. Co.; Dean Electric Co.; D. & W. Fuse Co.; DeVeau Telephone Co.; Bigley Tel. Co.; Dale Co., The; Dittrick-Jordan Electric Co.; Eureka Electric Co.; Engineer Pub. Co.; Edwards Electric Headlight Co.; Electric Appliance Co.; Electric Rotary Floor Polisher Co.; Electric Storage Battery Co.; Electrocraft Publishing Co.; Electric Service Supplies Co.; Electrical Review; Erwin & Co.; Electrical World; Engineering World; Edison Mfg. Co.; Electric Cable Co.; Enamel Metals Co. (Enameled); Ft. Wayne Electric Works; Federal Electric Co.; Faries Mfg. Co.; Grubbe, Emil H., M. D.; Guarantee Electric Co.; Gould Storage Battery Co.; General Electric Co.; Haller Machine Co.; Haines, J. Allen; Holzer-Cabot Co.; Hamburger, Felix; Helios Mfg. Co.; Hepburn Tel. Co.; Hart Mfg. Co.; Hunter Illuminated Car Sign Co.; Indiana Rubber & Insulated Wire Co.; Johns-Manville Co.; Kellogg Switchboard & Supply Co.; Keystone Electrical Instrument Co.; Lang, J., Electric Co.; Locke Insulator Mfg. Co.; Lyon Metallic Mfg. Co.; Monarch Electric & Wire Co.; Mathews, W. N. & Bro.; Metropolitan Electrical Supply Co.; McRoy Clay Works; Miller Anchor Co.; National Carbon Company; National Battery Co.; Nernst Lamp Company; Nungesser Battery Co.; Nurnberg Flaming Arc Lamp Co.; New York & Ohio Co.; Nuttall Co., R. D.; Oliver Mfg. Co.; Ohio Brass Co.; Oneida Community, Ltd.; Okonite Co., Ltd.; Peabody Coal Co.; Phoenix Glass Co.; Petersen, H. A. Mfg. Co.; Peirce Specialty Co.; Public Service; Phelps Co.; Paiste Co., H. T.; Phillips Insulated Wire Co.; Packard Electric Co.; Protected Rail Bond Co.; Reynolds-Dull Flasher Co.; Roth Bros. & Co.; Rock Island Battery Co.; Reed Electric Cordage Co.; Shelton Electric Co.; Schureman, J. L. Co.; Stromberg-Carlson Telephone Co.; Swedish American Telephone Co.; Simplex Electric Heating Co.; Schott, W. H.; Stolz Electrophone Co.; Sangamon Electric Co.; Stanley & Patterson, Inc.; Sarco Co., The; Sterling Electric Co.; Sterling Varnish Co.; Speer Carbon Co.; The Consumers Co.; Telephony Pub. Co.; Universal Mfg. Co.; Universal Electric Storage Battery Co.; University of Illinois; Vulcan Electric Heating Co.; Vim Company; Vote-Berger Co.; Vesta Accumulator Co.; Wagner Electric Mfg. Co.; Western Electric Co.; Westinghouse Electric & Mfg. Co.; Western Electrician; Western Insulator Co.; Wilson Trolley Catcher Co.; Wire & Telephone Co. of America; Whitney Electrical Instrument Co.

Following the precedent established by the directors of the Electrical Trades Exposition Company a year ago, Managing Director Niesz is sparing no expense or effort to make the coming show the greatest and most interesting trade exposition ever held in Chicago. It will be more than liberally advertised and special inducements will be offered to attract the attention of the public to the affair. The 201st anniversary of the birth of Benj. Franklin will be marked by a special program Thursday, Jan. 17, and handsome souvenirs will be distributed. Monday, Jan. 21, will be "telephone" day, and another appropriate souvenir will be given away. Thomas A. Edison day will be observed Wednesday, Jan. 24, an occasion for another souvenir. During the two weeks of the exposition there will be several important meetings of electrical organizations, notably the Northwestern Electrical Association, which has its annual convention at the Coliseum January 16, 17 and 18. This affair is usually held in Milwaukee, but as a compliment to the Chicago members of the organization, many of whom are identified with the electrical show, the meetings are to be held in Chicago. The Sons of Jove will have a rejuvenation on Wednesday night, Jan. 16, and the Illuminating Engineers' Society will meet Thursday, Jan. 17. The American Electrical Salesmen's Association will have its annual meeting Wednesday, Jan. 24.

Ellery's Royal Italian Band has been engaged for afternoon and evening concerts throughout the two weeks of the show and the Coliseum Annex will be converted into an electrical "Midway." Several new and interesting amusement features along electrical lines have been secured.

A PRACTICAL TEST OF THE TIRRIL REGULATOR.

The Tirril automatic voltage regulator consists in principle of a vibrating tongue which short-circuits the field-regulating resistance of the generator or of the exciter several hundred times a minute. The proportion of each period during which the short-circuit lasts is automatically varied according to the generator volts, with the result that the generator voltage can be maintained practically constant in spite of variations of load or speed. In a paper recently read by Her Klicpera, before the Electrotechnik and Machinenbau, some very interesting results obtained by the use of this regulator are described. The station is an alternating current one, and among its customers is a particular paper mill at a distance of 17 miles, for which a separate 300 kilowatt generator is run. Energy to the extent of 300 horsepower or 350 horsepower is required for motive and lighting purposes at the mill, as well as for about 1,200 lights and 50 horsepower in motors taken off the main between the supply station and the mill. Hand regulation was found perfectly satisfactory until last year, when a wood-sawing factory was erected at the mill. The load fluctuations then became very great (varying between 50 kilowatts and 300 kilowatts), that in spite of the greatest care, hand regulation of the exciter shunt resistance and of a resistance in the alternator field winding failed to produce a satisfactory voltage curve. Running two generators in parallel under half-load did not improve matters much, and the introduction of an ordinary automatic field regulator worked by a solenoid connected to the 'bus bars was found quite useless,

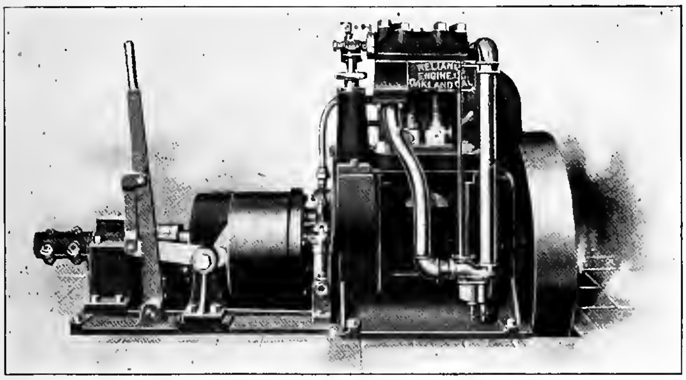
except as regards relieving the switchboard attendants somewhat.

Finally, a Tirril regulator was tried. A constant resistance was kept in the alternator field, and the regulator was arranged to adjust the voltage by intermittently short-circuiting a resistance in the exciter shunt. The result was quite satisfactory, giving a voltage curve which was practically a straight line. The regulator has been in use for nearly a year without interruption.—The Electrical Engineer (London).

A NEW TYPE OF GAS ENGINE.

The Reliance Engineering Company of Oakland has recently developed a new type of gas engine especially suitable for marine work. This company has worked persistently to put forth a design which not only permits great economy in construction, but one which is adapted to the most trying conditions met with in practice. A successful designer in this class of work must be familiar with the properties of the oils found on the market, as well as with the effects of variations in the temperature, humidity and purity of the air, which goes into the explosive mixture.

In this engine the oil is usually first passed through a fine mesh screen to separate the solid particles and grit, and then over a catch-pit to free it from moisture. To get air of a uniform and pure grade, an air jacket is placed around the lower part of the cylinders, and extends up a considerable



New Marine Gas Engine of the Reliance Engineering Co.

distance. The jacket is made large in order to give the dust in the air a chance to settle and the moisture to condense. The upper part of the jacket is quite warm when the engine is operating and heats the air to a uniform temperature. This is a necessary feature when operating in cold weather.

The splash system of oiling is used in connection with forced feed lubrication obtained by means of a small piston pump. The splash oil has the advantage that it continuously washes the grit from the working parts into the bottom of the pit, but in case the operator should allow the oil to become too low to lubricate efficiently, the most important working parts are provided with the positive oiling device operated by the piston pump.

In order to obtain the rigidity essential to smooth running the cylinders are bolted directly to the cast-iron frame of the base. This gives the engine a neat and compact appearance. Many devices are employed to prevent injury to the engine due to an oversight or blunder on the part of the operator, and to facilitate starting, a relief cam is provided to prevent compression while the crank is being turned by hand.

ELECTRIC SIGNS AND THEIR CONSTRUCTION.

Few people realize the ingenuity, skill, technical knowledge and good judgment required to successfully construct and put up electric signs. Mr. W. C. Brumfield of the Novelty Sign Company, 837 Ellis street, San Francisco, recently said that special designs should command much higher prices than are at present obtained for them on account of the extensive experience and special facilities necessary, just as the reputable surveyor receives $500 for an hour's work in performing a difficult operation.

Customers whom the advertising manager has succeeded in convincing that electric signs are paying investments, usually require several designs to be submitted. To do this work properly requires head designer and several assistants, all of whom must be skillful with the small brush and be fairly good draftsmen. The head designer must have original ideas and be able at a moment's notice to furnish sketches of signs appropriate and pertinent to the business of the advertiser.

The erection of large roof signs calls for considerable knowledge in designing metal supporting frames of ample strength to withstand maximum wind pressure without giving them a clumsy appearance. A competent electrical engineer is also necessary to secure safe and permanent ironing, and to solve problems connected with the construction of special live boarders, flashing effects, changeable letters, etc.

The man in charge of the finishing of signs must be thoroughly acquainted with the different methods of coating and the compounds used, such as fire enamel, japan enamel, air drying enamel, smalt, and others. A poorly finished sign may cost the manufacturer a great deal of money, as the finish will peel off, causing a great dissatisfaction on the part of the purchaser. Sometimes when rush orders are sent in, with instructions to deliver by a certain day or not at all, the finish is not given sufficient time to dry, with the result that its durability is destroyed.

Since the fire about three hundred electric signs have been put up in San Francisco, and judging from the way orders have been coming in recently, the Novelty Sign Company believes that in a short time the display will equal that of the days before. And, considering the progressiveness of the San Francisco business element, the time will come when her main thoroughfare, like that of New York, will be known by night as "The Great White Way."

SPLICING BROKEN ARMATURE PARTS.

A method of splicing broken armature shafts which is proving satisfactory has been developed at the Columbus, O., shops of the Indiana, Columbus & Eastern Traction Company. Shafts broken near the gear or on the taper at the pinion end are easily repaired so that the armature may be used until it is necessary to tear down the winding for some other reason.

The method of making this splice is simple. The broken end of the shaft is turned down in the form of a cone, longitudinal grooves being cut in its surface. After this is done another piece of shaft steel is hollowed out, cup-shape, to fit the taper snugly. One-fourth of an inch of spelter is placed in the bottom of the cup. The two parts are fitted together and placed in a screw jack or wheel press and are then heated by means of a coke air-blast flame which is made to circle around the shaft. As the parts to be spliced are heated pressure is applied through the screw jack and the spelter is forced from the bottom of the cup to all parts of the taper. When the shoulders of the two pieces are brought together the weld is complete. The shaft is then placed in the lathe centers and trued. The method described has been used very successfully and in many instances the welded shafts are still in use after several months of severe wear.—"Electric Railway Review."

NEWS NOTES

ELECTRIC RAILWAYS.

Sacramento, Cal.—The report was current last week in San Francisco that negotiations were pending in New York for the sale of the Pacific Gas & Electrical Corporation to the Western Power Company, a corporation allied with the Western Pacific. The Pacific Gas & Electrical Corporation controls the Sacramento Electric, Gas and Railway Company of Sacramento, and reports were current in that city that the street car line here had passed into the hands of the Gould interests. The story, however, is denied by John A. Britton of San Francisco, General Manager of the Pacific Gas & Electric Corporation. Mr. Britton declared emphatically that there was no was no truth in the report. He said that the Pacific Gas & Electric Corporation had not sold out to the Western Pacific, the Western Power Company, the Gould interests, or to anyone. The Sacramento street car system was inspected during the past week by a corps of engineers, and their visit, together with the report that negotiations for the sale were being made, is what gave rise to the report that the road had changed hands. It is said, however, that the engineers were merely representatives of the bond holders who make annual inspections of the holdings of the corporation, and that their visit was not out of the ordinary.

Boise, Ida.—The Boise R. R. Co. has been incorporated for the purpose of purchasing the Natatorium & Boise Traction Co. Capital stock, $900,000.

Caldwell, Ida.—Henry W. Dorman has applied to council for the construction and operation of an electric line in this city.

Lewiston, Ida.—It is reported that the Walla Walla & Columbia River Traction Co., will, the first of the year, place surveyors in the field at Dayton, Wash., to commence work on a permanent survey of an electric line to this place.

Spokane, Wash.—Work has been commenced by the Washington Water Power Co. placing its electric light and power wires under ground. The work will cost $500,000.

FINANCIAL.

Pacific Grove, Cal.—A transfer of the control of the Monterey and Pacific Grove Electric Railway has taken place. C. W. Allen and R. C. P. Smith have sold their interests in that line and in the Monterey County Gas and Electric Company to George Heazelton of San Francisco and E. P. Bolles, President of the First National Bank of Oakland. Extensions of the present Presidio line, through Pacific Grove to Carmel-by-the-Sea, and from Del Monte to Vista del Rey, are projected, as is also a line to Salinas. W. H. P. Hill has been appointed Manager.

San Francisco.—Holders of 3,843 shares of the California street cable road, which represents considerably less than a majority of the stock, held a meeting a few days ago, at the request of President Stetson, and unanimously voted down the proposition of selling to the United Railroads. The proposed sale has been talked of for several months. In fact, before the fire there was considerable talk of a merger with the United Railroads, but no agreement as to values could be reached.

Redding, Cal.—The Northern California Power Company has secured a permanent injunction in the Superior Court against the Shasta Power Company, a rival concern, preventing it from stretching its wires over the wires of the complaining company. Under the conditions of the injunction, the new company must stretch its wires beneath them and raise the Northern California Company's wires at its own expense.

TELEPHONE AND TELEGRAPH.

Berkeley.—Initial steps were taken at the meeting of the Conference Committee of the improvement clubs last week to consider the legality of the action of the Town Trustees in allowing the Home Telephone Company a fifty-year franchise in the ordinance passed to print at the recent meeting of the City Council. The objection to the fifty-year franchise on the part of the improvement clubs is based on the ground that the rival company will be enabled to gain back its initial expense of laying lines in a period of ten years, the operations during the remainder of the fifty-year term being clear profit. Victor J. Robinson, who acted as chairman, expressed himself as believing that a gift had been tendered the company by this long franchise.

Los Angeles.—An ordinance has been passed by the Council creating a conduit district and prohibiting the erection of poles and wires within the district.

Ukiah.—It being proposed to grant Charles L. Dearborn of Melbourne, Mendocino County, Cal., a franchise to erect and maintain a pole line for conducting telephone and telegraph lines over certain highways in Mendocino County, sealed bids will be received up to January 29th by the Board at Ukiah, Cal., for such franchise.

Marysville.—The Town Trustees of Wheatland have received application for a telephone franchise, the line being promoted by the dredger operators on Bear River, to run across the Horst and Drescher lands into Wheatland.

Mendocino.—The new Melbourne telephone line will probably be extended to Orr's Springs soon. This line has been constructed by private parties.

Petaluma.—A new direct telephone line will soon be built from Petaluma to San Francisco. Other additions are the building of through lines from Ukiah to Wendling and Albion, Mendocino County.

Arroyo Grande, Cal.—Arthur Tulford and James Fulton of San Luis will construct a telephone line between Arroyo Grande and the Crystal Oil Company's well.

Helena, Mont.—The Montana Independent Tel. Co. has had plans drawn for the erection of an exchange at this place to be completed June 1.

Spokane, Wash.—The manager of the Pacific States Tel. & Tel. Co. states that $175,000 will be expended by the company in improving its service in this city.

Sherwood, Ore.—The Sherwood Mutual Tel. Co. has been incorporated by J. P. Young, L. S. McConnell and Ferd Langer.

Baker City, Ore.—R. C. Robertson and associates, of Portland, have applied for a 20-year franchise for a new telephone system.

Wilson Creek, Wash.—The Wilson Creek Tel. Co. will incorporate with a capital of $2,500.

Aberdeen, Wash.—The Sunset Tel. Co. has moved their exchange into their new building on Wishkah St.

Boise, Ida.—The Independent Long Distance Tel. Co. will on January 14 vote to increase their stock from $750,000 to $1,000,000.

Bellingham, Wash.—The Farmers' Mutual Tel. Co. decided to erect a brick building for station purposes at Lynden. The company is also erecting a new line between Ferndale and the Anatole district.

Kent, Wash.—A. T. West has applied for a franchise for the erection and maintaining of a system of telephone or telegraph lines in Kent.

POWER AND LIGHT PLANTS.

Ashland, Ore.—R. McMurphy and associates have applied for a 25-year franchise for a gas heating, light and power plant.

Grace, Ida.—The Telluride Power Co., of Salt Lake City, will construct a power plant here at a cost of $1,000,000.

Kalispell, Mont.—The Flathead Valley Water Power Co. has incorporated with a capital of $350,000 by A. W. Howard, Russell M. Simmons, P. H. Bartelme, Warren Nichols and H. D. Folsom, Jr.

Starbuck, Wash.—Dr. M. Pretrycki will build an electric light plant at this place.

Seattle, Wash.—The municipal water and lighting department has received word that the carload of wire has been shipped from Newark, N. J., and will arrive here about January 10.

Tenino, Wash.—W. A. Freeburger, of Montesano, has purchased a controlling interest in the plant of the Tenino Light & Water Co.

Wenatchee, Wash.—The Wenatchee Electric Co. will increase its capital stock from $25,000 to $150,000. The company plans extensive improvements.

Baker City, Ore.—J. K. Rowing, president of the Eagle River Power Co., has closed a contract with the General Electric Co. for a complete equipment of machinery to develop 2,500 horsepower at the new Eagle River power plant at Sanger.

Trent, Wash.—Work has been started by the Trent Power & Irrigation Co. on the power plant which is to develop 1,500 horsepower.

Selma, Cal.—The San Joaquin Power & Light Company has about consummated a deal for the purchase of the Selma Light & Water Company. Manager Wishon, of the electric company, anticipates the successful culmination of the deal and expects the new company to be in charge by the first of the new year.

The Palms, Cal.—Arrangements have been completed for the building of an electric light plant here. Public subscriptions have been received sufficient to pay for lighting of the city for six months.

Ely, Nev.—This city is to have another modern electric light plant, and actual work of construction has already started. William V. Lockwood, who built a power and lighting plant here several years ago, has formed a new company and intends to give the mines of Ely more power and light and to expend over $100,000 in building a power house and equipping it with the latest electrical machinery.

Loyalton.—This city is agitating the purchase of the local lighting system and plant.

Vallejo.—The Vallejo Gas Company is again enlarging its plant.

Compton, Cal.—Sealed bids will be received by the Board of Trustees up to February 19th for a franchise for the construction and maintenance of poles, wires and other apparatus for furnishing electrical energy for lighting, heating and power purposes. A certified check for the full amount of the bid required should accompany each proposal, being made payable to the City Treasurer.

Compton.—The Trustees have an electric light franchise for sale, which will be purchased by G. R. Fulton. As soon as legal forms are complied with a company will commence

Pasadena.—The contract for the erection of a corrugated iron building to house the municipal electric light plant, has been let to Ellsworth & Co. for $1,748.

Santa, N. M.—Application has been made to the Town Council of Aztec, N. M., by H. H. Matheson for a franchise to erect and operate an electric light plant and furnish current for lighting and other purposes. He says it will take about sixty days to install this plant.

TRANSPORTATION.

Oakland.—The contract has just been let to the Hammond Lumber Company for 6,000 piles, the first section of what is practically an almost unlimited order for the construction of the new harbor docks and terminal basin of the Key Route system, which, when completed, from the estimates of the consulting engineer, Howard Holmes, will involve an expenditure of $10,350,000. The real purpose of the application of the Key Route people for a franchise on Wood street has also come to the surface in the full outline of the plans of the company for the construction of this new harbor. According to the plans, they will dredge out the basin in front of the bulkhead, which they have constructed to a depth of thirty feet at low tide, thus enabling vessels of the largest draft to enter the basin and moor alongside the berths. These docks will be 100 feet wide and 1,000 feet long, and will give room for 228 ships. Each dock will be reached by a spur track, and thus it will be possible to load the consignment of silks and teas and other products of the Orient directly from the ship to the freight cars. One of the most important provisions in the plan is for the ferrying of freight cars from the basin to San Francisco, thus enabling Eastern shippers on independent lines to come to tidewater and have their cars transferred to the San Francisco water front.

San Francisco.—The Board of Supervisors has passed, unanimously, a resolution of intention to rebuild the Geary street cable system for the city, with an overhead trolley equipment. The route of the proposed municipal electric road is to be along Geary street, Point Lobos avenue and Tenth avenue, southward to Golden Gate Park. The clerk was instructed to prepare the necessary orders and ordinances to initiate the proceedings of taking possession of and rebuilding the road.

Napa.—W. M. Rank, Manager of the Napa and Lakeport Electric, with a party of five people, has been over the proposed route.

Los Angeles.—The Interurban Railway has secured a fifty year franchise. The Fourth street franchise is directly in line with the proposed extension of the Los Angeles Railway through Eagle Rock Valley and Glendale, and is likely to be turned over by the Interurban.

Los Angeles.—Monday is the day set for passage of the privilege permits asked for the Harriman interests, which seek to build subways under public and private streets in Los Angeles about six miles long, and also extensions of surface lines to connect new and old routes.

Torreon, Mex.—Dr. J. Limm of the Mexico-Chinese Bank in this city has obtained from the government of the State the concession to build another electric street car line here. Work will commence in four months.

Chihuahua, Mex.—The city of Parral is to have an electric street car system. Local capitalists of that place have organized a company for that purpose. C. H. Bailey and Leopoldo Iwonsky are among them.

Los Angeles, Cal.—Arrangements have been made with H. E. Huntington whereby the present Stephenson avenue line of the Los Angeles railway, which terminates at Indiana street and Stephenson avenue, will be extended up Indiana street to Fifth street. The new car line will be in operation in a month.

Los Angeles, Cal.—It is rumored in railroad circles that the St. Louis Car Company is considering establishing a plant here for the manufacture of electric cars.

Bisbee, Ariz.—The Bisbee district is soon to have an electric railway which will extend from Bisbee and touch as many of the Copper Queen and C. & A. mines as the topography of the country will permit. Bids for the construction are being advertised for.

TRANSMISSION.

Redding.—The Northern California Power Company will erect a new plant on the mouth of the Jenny Creek, and surveys for the pipe line will be commenced as soon as the company's engineer arrives.

Modesto.—The Board of Supervisors will receive bids up to January 16th for the installation of an electric plant for pumping purposes at the County Hospital, according to plans and specifications on file with W. J. Marin, Clerk.

Los Angeles.—H. H. Clark, a prominent mining man of Nevada, is in the city, and states that he proposes to develop electricity from the Kings River high up in the Sierras on the dividing line between California and Nevada. Thus far he alone is interested in the project, which will mean an expenditure of not less than $6,000,000 in the construction of dams, generating plants, transmission lines, which will convey power to Los Angeles, San Francisco and the various mining camps in Western and Southern Nevada. The site of the proposed plant is near the narrow gauge road running from Sodaville, Nev., to Keeler, Cal., which is controlled by the Southern Pacific. Mr. Clark will soon leave for Niagara Falls, where he will inspect the big electrical power plants and decide upon the machinery necessary.

Venice.—The miniature plant at the north end of the Breakwater, built for demonstrating purposes, has passed into the control of the Los Angeles Wave Power and Electric Company, a new concern incorporated under the laws of Arizona with a capital of $3,000,000. E. C. Phipps, one of the new company, was identified with the builders of the local plant, and will continue to make his headquarters here. Inventor Fred Starr and J. H. Bacon, promoters of the Starr Wave Motor Company, have left for Washington, D. C., from which point they will go to Atlantic City, N. J., to begin work on the construction of their proposed commercial plant.

POWER AND LIGHT PLANTS.

San Jacinto, Cal.—Messrs. R. G. Dunn, C. A. Watson, and Horace Slater, of Redlands, the promoters of the gas plant for San Jacinto and Hemet, are in the valley making arrangements. The mnaufacturing plant will be established on Menlo avenue, on the Santa Fe R. R., midway between San Jacinto and Hemet. Construction work will comemnce in the immediate future.

Redding, Cal.—The plant of the Redding Gas Company, owned by the Northern California Power Company, is to be enlarged immediately by the addition of a new gas holder, or tank. The new holder will have a capacity of 15,000 cubic feet, while the one now in use has a capacity of 10,000 cubic feet. Bids are now being advertised for the installation of the new holder.

Calgary, Alta.—W. M. Alexander, of Brandon, Man., has applied for a franchise to build and equip an electric light plant, also an electric street railway.

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American and Foreign Vertical Engines.

It is generally conceded that the high speed engine has been developed in England to a higher degree of perfection than in any other European country or in America. The vertical compound and triple expansion engines of high power, both for low and high speeds, are, perhaps, more commonly employed in modern English power plants than any other type.

In America, also, this engine is largely used, probably more so than engines of the horizontal type. Fig. 1 shows a characteristic high-power American engine used for driving large generators. This engine was built for the power station of the Cincinnati Gas and Electric Co. by MacIntosh Seymour & Co., and can develop about 5,500 horsepower. The cylinder dimensions are 40 and 82 by 54 inches. Two 1250-kilowatt continuous current generators are driven at a speed of 100 revolutions per minute.

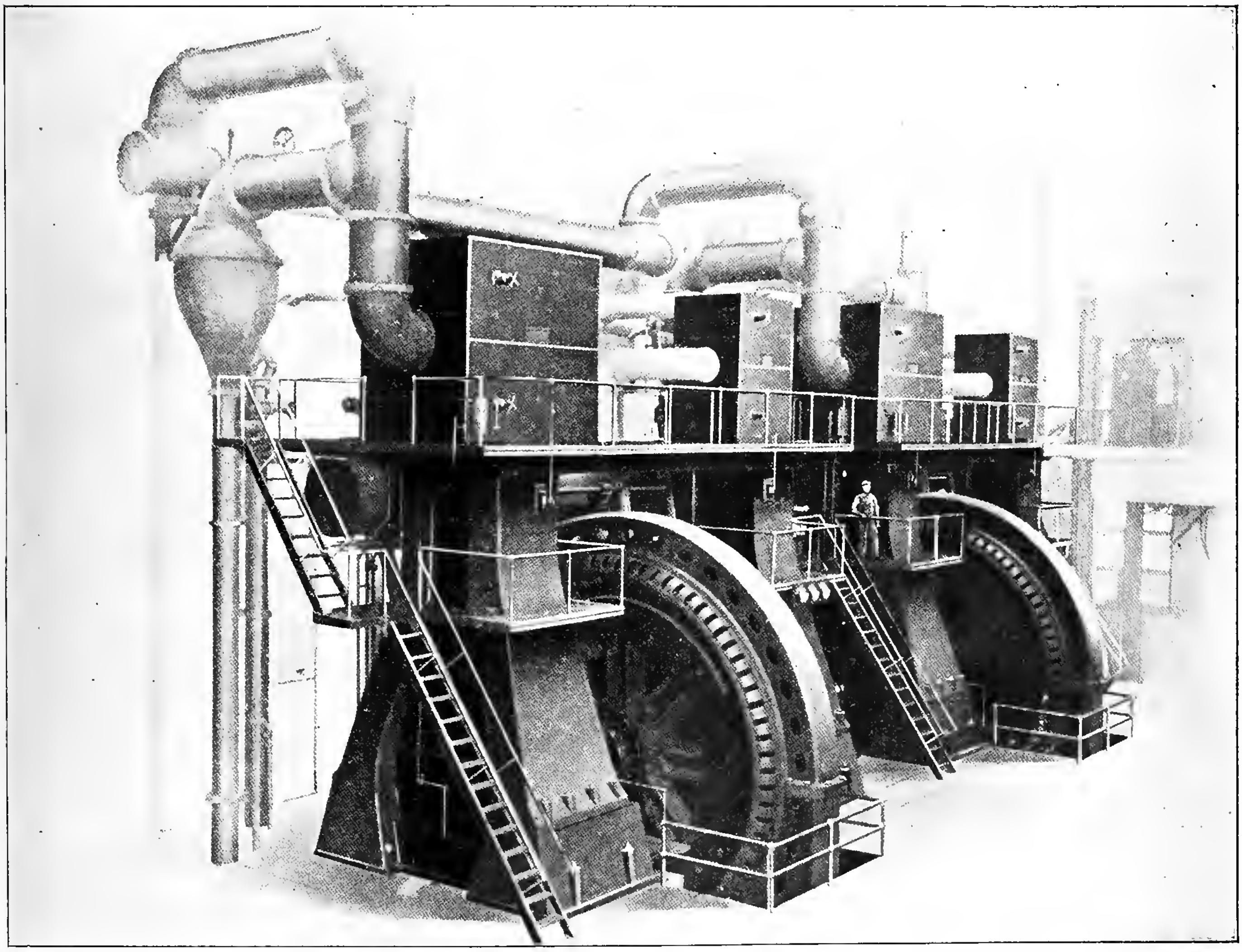


FIG. 1. AMERICAN VERTICAL CROSS COMPOUND McINTOSH & SEYMOUR ENGINES OF 3,000 TO 4,500 HORSEPOWER AT THE POWER PLANT OF THE UNITED RAILWAYS & ELECTRIC CO. OF BALTIMORE, MD.

Fig. 2 represents a distinct type of a French triple expansion engine, having a capacity of 1200 horsepower. Fig. 3 shows a vertical compound engine of German design direct connected to a dynamo supplying continuous current at a pressure of 500 volts. The valve gear is constructed according to the Lentz system. Another German compound engine is that shown in Fig. 4, having been built in Stuttgart by G. Kuhn.

An interesting power plant where vertical engines are employed is that of La Compagnie Parissienne de l'Air

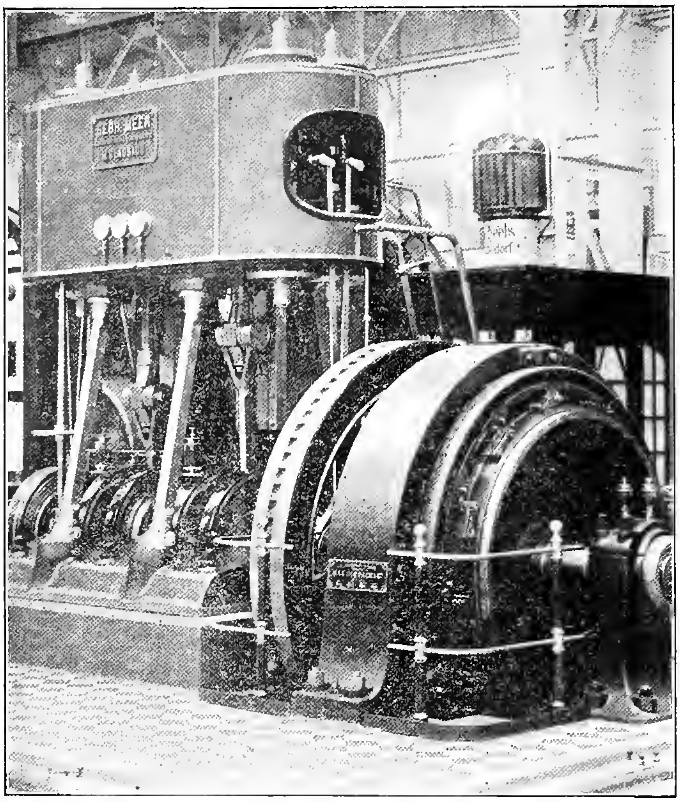


FIG. 3. 250-KILOWATT, 500-VOLT SCHORCH DIRECT CURRENT DYNAMO DIRECTLY COUPLED TO VERTICAL COMPOUND STEAM ENGINE, BUILT BY GEBR. MEER, OF M. GLADBACH.

Comprime, situated near the quay of Jemmapes in Paris. This plant was designed for a total capacity of 27,600 horsepower, and consists of 23 units. The plant is built on a site trapezoidal in shape, 90 meters (295 feet) in width, with a frontage of 60 meters (197 feet) on the wharf. On account of the large output required and the small area available it was not possible to adopt the usual custom of placing the engines on the same floor with the boilers. The engines and electrical generators are installed on the first floor, the boilers on the second, and the storage for the fuel on the third floor. A gallery is provided for the switchboards and feeders, communicating at the right and left with the engine room by staircases. The auxiliary apparatus, which includes pumps, coal elevators and hoists, is in the center of the plant and is separated from other machinery by a passage 16 feet in width.

The coal is delivered to the station in boats in quantities of several tons per day, and is mechanically unloaded; brought to the foot of the elevators and automatically dumped into the hopper of an elevator which carries it to the top of the building. The usual endless chain conveyors are employed, being operated by electric motors. The feed water is taken from the city mains, which derive their supply from the Orcq and the Seine rivers. After the water is filtered it passes to an underground reservoir having four compartments with a capacity of 44,000 cubic feet. Electric motor driven pumps raise the water to storage reservoirs situated under the boilers. The condensation water is taken from the canal above the power plant through a pipe 43 inches in diameter, and passes around the engine installation into a canal around the outside walls of the station. Each set of four boilers feeds the vertical steam engine installed directly below it, the quantity of steam for each unit being about 17,200 pounds per hour.

The great economy in floor space by using the vertical steam engine over the horizontal type is well illustrated in this electric station, and the equipment, therefore, deserves a somewhat more detailed description. The boilers are of the tubular type, each supplying 5,500 pounds of steam per hour under a pressure of 114 pounds per square inch. A steam superheater as well as a feed water heater are provided for each boiler which has a fire grate surface of 56.5 square feet and a total heating surface of 2,330 square feet. The heating surface of the tubes is 1,425 square feet. When necessary, three boilers operating at their maximum capacity can supply a single unit, although under ordinary circumstances four boilers are used.

A peculiar arrangement of this boiler plant is that a separate chimney is provided for each group of boilers, the height being 645 feet and the diameter 6.5 feet, so that there is in reality a separate chimney for each 1,300 horsepower vertical steam engine and its group of four boilers. The engines have a steam consumption of 17.6 pounds per electrical horsepower hour, or 24.0 pounds per kilowatt hour. The tests of these engines showed a consumption of 14.3 pounds of steam per effective horsepower hour at the shaft.

The piston strokes measure 3.95 feet. The engine shafts are constructed of mild steel, are 29.5 feet long and weigh 10 tons. There are six bearings to each unit, two outside and four intermediary. One end of the shaft supports a 31-ton fly-wheel, 18.7 feet in diameter, and the other end of the shaft is connected to the dynamo rotor.

The dynamos are of the inner pole type, the current being collected on the periphery of the revolving armature.

There are twelve sets of brushes used in collecting the current. These are mounted on a spider having a diameter of 14.75 feet. The field consists of twelve poles of forged iron joined to a mild steel yoke. The load current is 1,500 amperes, the total power delivered by the generator is 750 kilowatts, at a pressure of 500 volts. Power is delivered to a number of sub-stations, one of which is located at Saint-Roch and another on Mauconseil street. The latter has four stories above ground and three underground, in which are placed the storage battery equipment. Each of the latter floors has four batteries of 280 cells each with five boosters and a switch board. These batteries have a capacity of 2,200 ampere hours, the normal discharge rate being 300 amperes. The boosters are four pole machines separately excited, two machines being mounted on the same shaft.

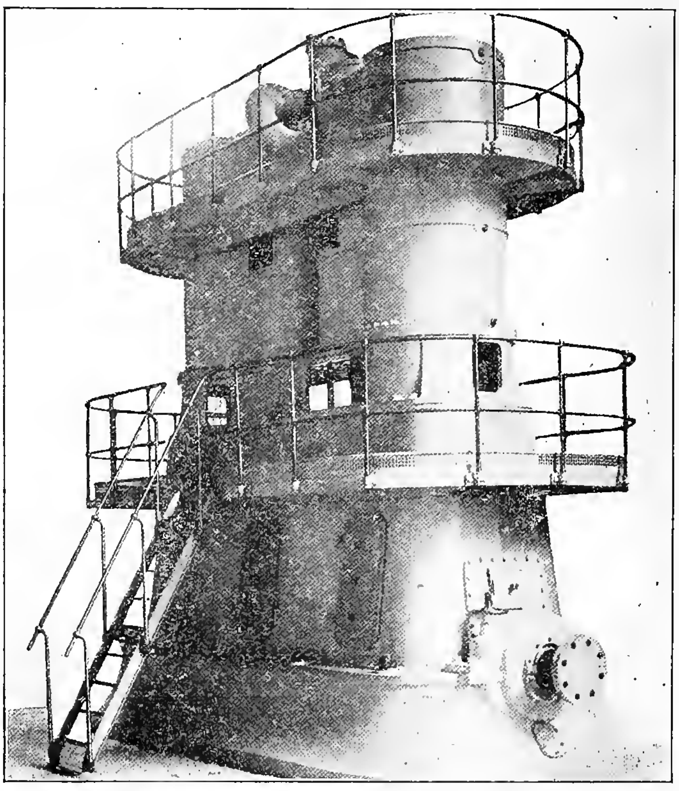


FIG. 2. FRENCH 1,200-HORSEPOWER TRIPLE EXPANSION ENGINE CONDUCTED BY THE SOCIETE ANONYME DES ESTABLISSEMENTS DELARMAY BELLEVILLE OF SAINT DENIS, FRANCE.

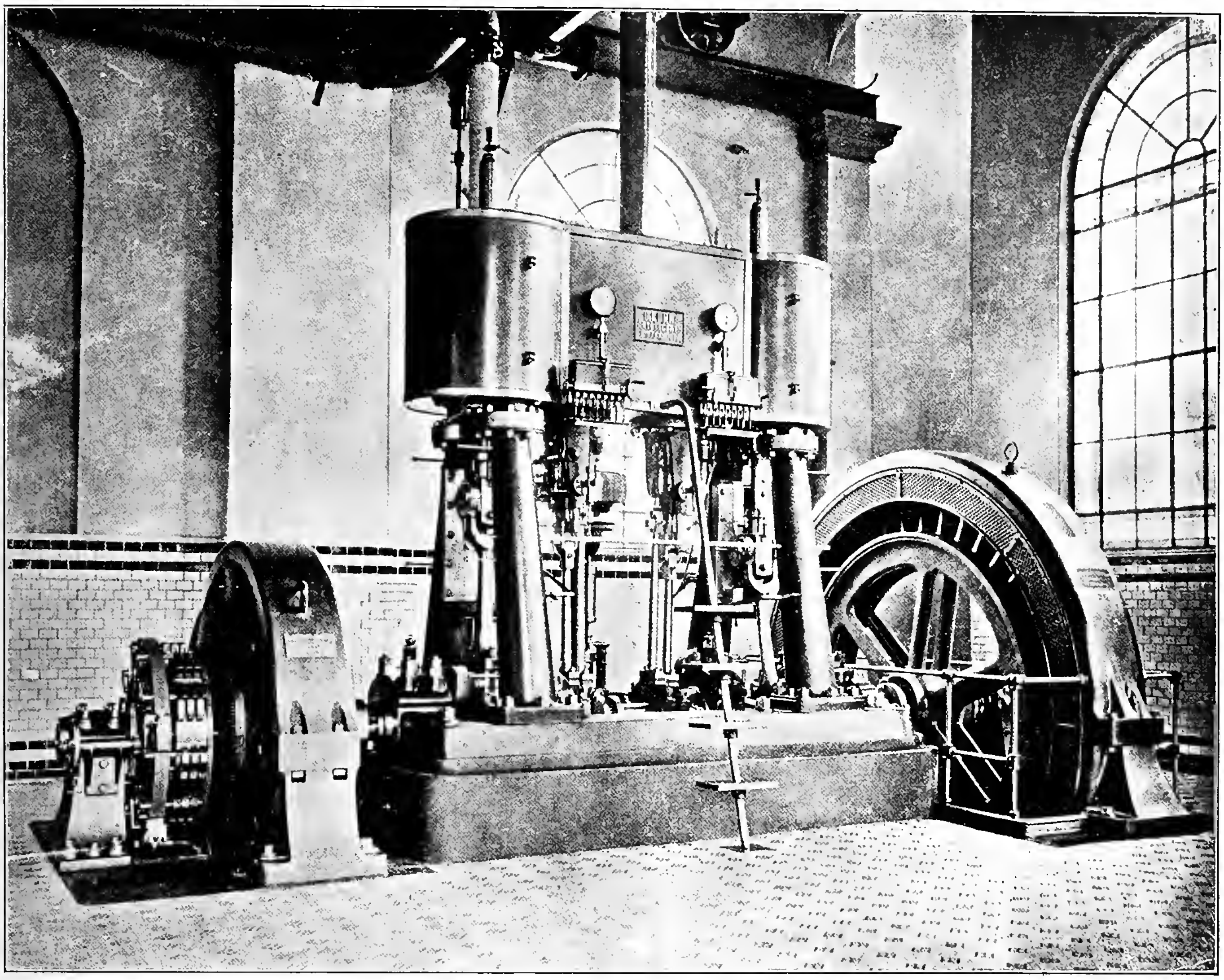


FIG. 4. DIRECT AND ALTERNATING STEAM GENERATOR AT LAHMEYER POWER PLANT.

DOUBLE TROLLEY SYSTEM NOT A SURE CURE FOR ELECTROLYSIS.

At the convention of the Central States Waterworks Association, held in Cincinnati, Ohio, a discussion upon electrolysis of water pipes was started by Joseph J. Pater, who stated that it was his belief that the only method of doing away with this trouble was to force all electric railroads to adopt the double trolley system. This opinion was dissented from by George Hornung, formerly superintendent of the Newport (Ky.) waterworks, and at the present time a consulting engineer of Cincinnati, Ohio. Mr. Hornung first stated that it was not entirely correct to attribute all electrolytic troubles to the street railway, as any stray current may cause electrolysis to take place, and such currents are almost always present in cities where there are large electric generating stations. It is practically impossible to insulate all the systems perfectly so as to prevent any leakage of current.

It is this very feature which defeats the purpose of the double trolley system, and he described, somewhat in detail, his experiences with that system in Cincinnati. The double trolley system, on account of its complicated structure, is much more difficult to insulate than the single trolley system, and this fact is realized in Cincinnati, where a fallen wire is treated with respect; in fact, Mr. Hornung stated that he has known horses to be killed by such wires. He mentioned an experiment conducted on Main street, in Cincinnati, at a time when there were two lines running down that street—one a single trolley, and the other a double trolley system. It was found that by transferring the trolley wheel of a car on the single trolley system to one of the double-trolley wires that the lamps in the car were lighted, and by turning the controller handle the motors, while not able to start the car, exerted a considerable torque. This experiment was repeated again several years later, with the same result.

NEW GAS MANTLE.

The "Scientific American" says that a German patent has been granted for a new process in spinning artificial threads made from cupric oxide and cellulose, and knitting the fabric for the mantles in the ordinary way. These mantles are subsequently impregnated with the thorium salts, and after drying are placed in a bath of ammonia, or hydrogen peroxide. This last bath is the essential point of the invention, as it converts the previously soluble salts into insoluble compounds, i. e., hydroxides. Since hydrogen peroxide only transforms the salts of thorium into an insoluble state, it is necessary to make use of a cerium bath, after the hydrogen peroxide treatment, in order to give the mantles the necessary one per cent of ceria.

TRACTION DYNAMICS.

By Elbert G. Allen, Chief Electrical Engineer of the Seattle Electric Co.

The energy required for moving any car is composed of three components: (1) that required to overcome the inertia of the car; (2) that required to raise the car against the force of gravity; and (3) that required to supply the losses of train resistance. In any closed cycle of train movement where the car returns to rest at the starting point the energy which was expended in overcoming the inertia of the car and in raising it against the force of gravity is returned to the car again. This returned energy may be again expended in train resistance losses or it may be that it is necessary to waste it in bringing the car to rest by braking. The ultimate causes for loss of energy are then train resistance and braking.

As is the case with any moving machinery, friction or train resistance cannot be avoided. It can be reduced somewhat by careful alignment of track, reduction of grades, easement of curves, etc., but in general the train resistance for a given class of cars at a certain speed is a fixed and unchanging quantity. In general, train resistance may be attributed to three causes: journal friction, rolling friction of wheel on rail, and wind resistance. Since the first component is independent of the speed, the second inversely proportional to it and the third varies with some power of the speed, the resulting total train resistance is a complex function of the speed.

For comparison, train resistance is usually expressed in pounds per ton weight of the car or train. Such figures are not consistent between various sizes of cars and under varying conditions, but as a means of comparison between cars of a given class, train resistance is very nearly proportional to the weight of the cars.

The wind resistance of a train consists of that of the pressure on the front vestibule, the suction on the rear vestibule and the skin friction of the air on the sides of the train. Consequently, the amount of wind resistance varies greatly with the shape of vestibules, amount of surfaces exposed per ton weight, etc. The Railway Test Commission of the St. Louis Exposition made a very interesting series of tests to determine the effect of shapes of vestibules on the wind resistance, and found that a flat vestibule creates the greatest air pressure, the standard form of vestibule being better, but a parabolic form being still better.

Wind resistance increases very rapidly with high speeds, becoming a very important factor in high speed work. In such cases the shape of vestibule should be very carefully considered in order that the amount of power absorbed may be minimized.

It should be borne in mind that for a given equipment, schedule and road bed, the power lost in train resistance cannot be decreased and, therefore, these conditions should be very carefully scrutinized in order that the losses may be kept as low as possible. Low maximum speeds are desirable from the point of view of power consumption.

Very reliable information has been obtained experimentally during the past few years regarding train resistance, and the General Electric Company's formulae and the results of the St. Louis Test Commission may be considered authoritative.

(Editor's Note—This paper is the first of a series of lectures which will be delivered during the ensuing year before the College of Engineering at the University of Washington and Seattle, by distinguished practicing engineers. The complete series of lectures will be published in the columns of the "Journal" as they are delivered.)

For city and suburban work where a speed of 30 m. p. h. is not exceeded it is ordinarily safe to assume that train resistance is 20 pounds per ton. For high speed interurban calculations the resistance varies with the speed so greatly that the more complex formulae must be used.

The loss of energy through braking is very variable and largely affected by conditions of schedule, grade, etc. For a certain class of service the amount of braking is almost solely responsible for the widely different number of watt hours necessary for each ton mile of car travel, due particularly to the "personal equation" of the motorman. It is, therefore, very important that schedules, gear ratios, grades, etc., be selected so far as feasible with a view to reducing the amount of braking necessary.

Steep grades increase the loss of energy through braking; for on all grades steeper than about one per cent, the component of the car's weight tending to propel the car exceeds the train friction and in order to prevent acceleration the brakes must be applied. Thus the energy which has been stored in the car as potential energy on ascending the grade cannot be entirely utilized to overcome friction on descending.

As an example, on a certain line with a difference of elevation of 163 feet between termini, a car on test tools consumed 20.4 kilowatt hour outbound, making 24 stops, and 16.5 kilowatt hour inbound, making 16 stops. Correcting these values for the amount of energy necessary for overcoming grade, we find that the actual losses were 18.0 kilowatt hour outbound, and 18.9 kilowatt hour inbound, so that in spite of the less number of stops the inbound trip consumed nearly 5 per cent more energy, principally on account of the braking on down grades.

On another line about three miles long with a maximum grade of 11½ per cent and a difference of elevation of about 380 feet between termini, a car required 5 kilowatt hour per car mile outbound and 1.86 kilowatt hour inbound. Correcting these values for elevation we find the loss to be 3.25 kilowatt hour per car mile outbound, and 3.61 kilowatt hour inbound, an increase of over 11 per cent. Here the average grade is about 2.4 per cent, and theoretically the car should possess sufficient potential energy at the outer terminus to carry it to the other, while as a matter of fact, some 4.38 kilowatt hours were necessary.

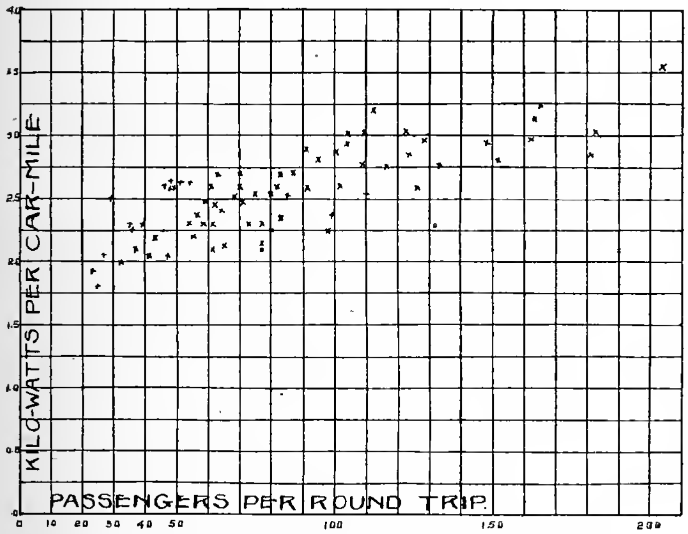
The schedule has a very important bearing on power consumption. With an easy schedule much drifting can be introduced into the car movement and braking be begun with a lower speed, so that less energy be actually lost from this cause. Mr. Gotshall, in his book on "Railway Economics," shows that in one case a decrease in schedule speed of 11.7 per cent allowed a decrease in energy loss of 48.8 per cent. Here, however, results may be very much altered by the personal characteristics of the motorman, and comparisons should be made with care.

The effect of gear ratio on power consumption is similar to that of the schedule in that it affects the amount of coasting possible. A high gear ratio means that a car runs at a low rate of speed, but has a high torque available for acceleration. Such a car can get up speed quickly, but its maximum speed is low. Where a car is obliged to accelerate frequently and does not ordinarily run any great distance at its maximum speed, as is the case in urban work, such conditions are desirable. In general it is best to use as low speed gears as possible and allow the required schedule to be made with ease. This is desirable for the equipment and power station, as the starting current is light. It gives minimum losses, as rheostat losses are small and the losses incident to high maximum speeds are cut down. One should not reduce the speed to such an extent that it is difficult to make the required schedule, but usually it is the other way. A car on a certain division showed an average consumption of 2.55 kilowatt hour per car mile with gear ratio 3.42 and 2.42 kilowatt hour per car mile with gear ratio 3.94, a decrease of 5 per cent. A single truck car on another division showed

a decrease from 2.78 to 2.39 kilowatt hour per car mile on changing the gear ratio from 3.55 to 4.85, a decrease of 13½ per cent.

The line voltage supplied has an effect on power consumption dependent on other conditions. If no attempt is made to hold the schedule and the proportion of coasting is maintained, a decrease in line voltage decreases the watt hours consumed per car mile on account of the decrease in motor and rheostat losses due to decrease in current values and decrease in train resistance losses due to decrease in speed. If, however, an attempt is made to maintain the schedule speed with low voltage, the power consumption may be increased even above normal as the increase due to cutting out coasting may overbalance the saving due to the decrease of losses with speed. Since the current values are increased in such a case due to rapid acceleration, the motor and rheostat losses are also increased.

Rates of acceleration, as well as braking, affect the power consumption, for with more rapid rates more ground is covered during periods of acceleration and more coasting may thereby be introduced. Increase in acceleration is obtained, however, at the expense of increased currents which tend to overload the motor and increase the motor and rheostat



PLOT SHOWING VARIATION OF POWER CONSUMPTION WITH NUMBER OF PASSENGERS CARRIED.

losses. Too high a rate of acceleration increases the motor losses on account of the high rate of input, too low a rate of acceleration increases the motor losses by increasing the length of time the motor must remain in circuit in order that the schedule may be maintained. A mean value giving minimum losses should be selected and the equipment adjusted for this rate.

The number of passengers carried on a car affects the power consumption somewhat, partly on account of additional weight carried, but chiefly because of the increase in the number and length of stops. Each stop adds directly to the power of consumption the amount of energy lost in braking to a stand-still, and indirectly by making the schedule harder to make and the coasting possible correspondingly less. The accompanying plot shows how the power consumption increases with the number of passengers carried. It also indicates what diversity of results may be expected from trip to trip on account of a change in motorman and incidental circumstances.

Theoretically, with no braking losses, it may be shown that the power consumption in watt hours per ton mile should be numerically twice the train resistance expressed in pounds per ton. Expressions for the theoretical loss in braking may also be worked out. While these values are good and valuable as a matter of comparison, and as a guide, the results obtained are lower than those obtained in actual operation on account of various factors which cannot be given consideration in a theoretical formula. As a basis of estimate it is best to use figures which have been obtained in tests under conditions similar to those under which the cars for which estimates are desired, will operate. Values of watt hours per ton mile will, of course, vary greatly. The St. Louis Test Commission gave results which may be considered typical. These results average 83 watt hours for an interurban car, 122 for a double-truck city car, and 162 for a single-truck city car. These values should not be used, however, without careful reference to the original report to check all conditions which existed in these tests.

Another factor which is as important, if not more so, than the watt hour or average loss, is the maximum power demand of a car or system, for this is what determines the number of feeders required and the size of generating or converting apparatus. With an interurban road which operates on a definite schedule with few stops and accelerations, the maximum demand may be foretold with considerable nicety by laying out current-time curves for each train and summing them in accordance with the result desired. With city and suburban systems, however, where cars are many and stops are made whenever necessary and where no feature of the operation can be foretold except schedule and speed, such methods are impossible.

For such cases one may well have recourse to the use of load factors. The load factor is the ratio of the average to the maximum demand, and is a fairly definite figure for a given condition. The average demand of a system is, of course, equal to the sum of the individual average demands of each car as it represents the total energy required. The maximum is, however, less than the sum of the various maxima as these individual maxima do not occur simultaneously. Consequently the load factor improves as the number of cars increases. For a single car during a run with ordinary length of stops the load factor may be as low as 10 or 12 per cent. From this the value increases till a large system of several hundred cars may have a load factor of 60 per cent. or better. The all-day load factor is, of course, much worse than this, as the average car miles of the day are much less than for the hour of maximum load. A large system ordinarily gives a daily load factor of 35 to 40 per cent.

To show the application of these figures let us assume a 50-car system of which 30 cars are 20-ton, double-truck, and 20 are 10-ton, single-truck. Let the average or schedule speed be 10 miles per hour and let us assume the average power consumption to be 135 watt-hours per ton-mile. Let us further assume that 20 double and 10 single-truck cars operate 19 hours per day; 5 double and 5 single-truck cars 5 hours, and the remainder but 3 hours per day. The total ton-miles per day will amount to 107,000, and the ton-miles during the maximum hour 8,000. Consequently the daily power consumption will be 14,445 kilowatt-hours, and that of the rush hour 1,080. If the load factor of the maximum hour be assumed to be 40 per cent., the maximum demand will amount to 2,700 kilowatts, or 54 kilowatts per car, and the daily load factor will be 35.5 per cent.

EARNINGS OF THE OAKLAND TRACTION CO.

The report of the Oakland Traction Company for 1906, just issued, shows that the traffic has almost doubled during the year, instead of increasing 15 per cent, as has been the case for several years previous. The owners of the Oakland Traction propose now to make important additions to their lines and for this purpose bonds to the amount of $12,000,000 will be issued at once, of which $7,000,000 will be held to pay off the present bonded indebtedness and $5,000,000 will be used for additional equipment and important extensions to the company's lines.

A COMPARISON OF UNIVERSITY AND INDUSTRIAL METHODS OF EDUCATION AND DISCIPLINE.*

By Mr. Frederick W. Taylor, President of the A. S. M. E.

The point from which I view college education is that of the employer, not that of the educator. I have had no experience with the difficult and complicated problem that faces the professors and the governing boards of our colleges. On the other hand, I have been engaged for years in organizing the shop, office, and commercial management of quite a wide range of engineering and manufacturing establishments. This has brought me into intimate personal contact with a large number of college graduates, and I have become well acquainted with their strong points, which are many, and at the same time with a few of those points in which it would seem that as a class they might be improved. And in what I shall say I have principally in mind the preparation of young men for success in commercial engineering and industrial enterprises; in other words, enterprises outside of the four learned professions.

I despise the pessimist who sees nothing but the defects and blunders of mankind; and the scold, whose pleasure it is to complain of all things as they are.

Let me say at the start, that without question, our college graduates as a class represent the finest body of men in the community. And as to the value of an engineering course for men in our profession, it has been shown through carefully-gathered statistics, that within a few years after graduation the college-educated engineer far outstrips in position and salary his average competitor who comes up from the ranks.

It would be a much more congenial task to dwell upon this view of the profession, but something may possibly be gained by considering what has seemed to many of the friends of our young graduates to be the one defect which they practically all have in common.

For a period of from six months to two years after graduating they are, generally speaking, discontented and unhappy. They are apt to look upon their employers as unappreciative, unjust and tyrannical, and it is frequently only after changing employers once or twice and finding the same lack of appreciation in all of them, that they finally start upon their real careers of usefulness.

On the other hand, the attitude of employers toward young graduates is fairly expressed by the following written instructions given for the selection of quite a number of young men to fill positions which presented opportunities for rapid development and advancement. These instructions were to give the preference—first, to graduates of technical schools; second, to the graduates of the academic departments; but to employ no college boy who had not been out for more than two years.

Why is it, then, that these young men are discontented and of practically little use during the first year or two after graduating?

To a certain extent this is unquestionably due to the sudden and radical change from years spent as boys almost solely in absorbing and assimilating knowledge for their own benefit to their new occupation of giving out and using what they have for the benefit of others. To a degree it is the sponge objecting to the pressure of the hand which uses it. To a greater degree, however, I believe this trouble to be due to the lack of discipline and to the lack of direct, earnest and logical purpose which accompanies, to a large extent, modern university life.

During the four years that these young men are at college they are under less discipline, and are given a greater liberty than they have ever had before or will ever have again.

*An address delivered at the dedication of the new engineering building of the University of Pennsylvania.

As to college discipline, it cannot be a good training for after life for a young man deliberately to be told by the university authorities that he can flagrantly neglect his duties sixty times in one term before any attention will be paid to it; while, if in business, the same young man would be discharged for being absent two or three times without permission.

And, as to the freedom offered by the modern university system, it is not true that boys from eighteen to twenty years old have the knowledge and experience necessary to select a logical and well-rounded course of studies, and even if they had this wisdom, the temptation to choose those studies which come easiest is so strong that it would be unwise to throw upon them so great a responsibility. Nor does it appear wise to leave each student free to study as little or as much as may suit him, at times doing practically no work for days, and at others greatly overworking, with no restraint or direction except the round-up which comes twice a year with examinations. At the least, it must be said that in commercial or industrial life this undirected liberty will never again be allowed them.

During the past thirty years two radical changes have occurred in educational methods. The kindergarten and its accompanying ideas has come for the children, and for the young men has come the change from the college, with its one or two courses carefully selected and rigidly prescribed by the faculty, to the university with as many different courses as there are young men, and in which, under the elective system, each student is given the choice of all of his studies.

The fundamental idea back of the change from college to university is excellent; namely, that of providing a far greater variety in the courses to suit the different tastes and abilities of the students, and to especially prepare them for their future occupations. Accompanying, however, this great step in advance, and yet, so far as I can see, in no way logically connected with it, has come the false step of giving our young men in many cases a greater liberty than is allowed, on the whole, to any other class of active workers; and of handing over to them the final decision in a subject most needing a master mind.

Commercial, manufacturing, and other enterprises in which many men co-operate, are managed more and more by delegating all important decisions to a few men whose judgment has been trained through long experience, study, and observation in those matters which they are called upon to decide. Yet many of our universities are managed by giving over to the young man, under the elective system, the final decision as to what studies will best fit him for his life's work, although he has, of necessity, but the vaguest idea of the nature of the subjects which lie before him. It is almost like asking him to lift himself up by his boot straps.

I cannot but think that in changing we have modeled largely after the English and German universities, which, as we know, are influenced in their management by traditions handed down through several hundred years; and that in adopting the great university idea of a variety of courses, we have at the same time blindly accepted the foreign idea of the elective system accompanied by a lax discipline, both of which are better suited to medieval times when each man worked for himself than to the present day when the road to success lies through true co-operation.

In this change, also, too great stress has been laid upon those elements leading to knowledge or book learning on the part of the student and too little upon the development of his character.

The kindergarten also, which has proved so great a help in training the younger children, making them observant and giving them a certain control over themselves, has brought with it one idea which has wrought great harm, and yet this bad idea is in no way properly or logically connected with the underlying principles of the kindergarten.

Somehow the average kindergarten child gets a firm conviction that it is the duty of the teacher to make things interesting and amusing, and from this follows soon the notion that if he does not like his studies and fails to learn much, it is largely the teacher's fault. Now, whatever views the parents or the teachers themselves should hold upon the duties of teachers, there is no doubt that the boys should have firmly in their heads the good, old-fashioned idea that it is their duty to learn, and not that it is the duty of the teacher to teach them.

Along with the kindergarten plan of interesting and amusing children, the idea has taken firm hold in a large portion of the educational world that the child and young man should be free to develop naturally, like a beautiful plant or flower. This may again be an excellent view for the older person to hold, but it is a distinctly bad one for the young man to act upon. He promptly translates the idea of development naturally into wishing to do only, or mainly, those things which he likes or which come easy to him.

Of all the habits and principles which make for success in a young man, the most useful is the determination to do and to do right all those things which come his way each day, whether they are agreeable or disagreeable; and the ability to do this is best acquired through long practice in doggedly doing along with that which is agreeable a lot of things which are tiresome and monotonous, and which one does not like.

Now neither the kindergarten idea, the university elective system, nor the lax college discipline tend to develop this all important habit in young men.

True co-operation, co-operation upon the broadest scale, is that feature which distinguishes our present commercial and industrial development from that of one hundred years ago. Not the co-operation taught by too many among those of our trades unions which are misguided, and which resembles the co-operation of a train of freight cars; but rather that of a well-organized manufacturing establishment, which is typified by the co-operation of the various parts of a watch, each member of which performs and is supreme in its own function, and yet is controlled by and must work harmoniously with many other members.

It is a mistaken notion that character of this kind needed for successful co-operation is developed by the elective idea of allowing each boy to choose for himself those things which he will do. It requires far more character to do successfully those things which are laid out for one by a wiser man than to do only what one likes, and in modern co-operation, while the work of each man is modified and more or less controlled by that of others, there is ample scope left for originality and individuality. We must remember that of all classes in the community, college boys are being trained to fill some day the position of leaders in the co-operative field. And there is no fact better established than that the man who has not learned promptly and fully to obey an order, is not fit to give one.

An examination of the studies chosen by boys in the university academic departments will show that the logic and motive back of about one-half of the students is that of obtaining an easy course, and even better students show generally a lack of clear-cut logical purpose in their selection. In their case, the studies are chosen because the young man likes or is interested in the subjects, or because they come easy to him, rather than because they give a well-rounded and balanced course with a distinct logical purpose. The loose, flabby, purposeless courses chosen by fully one-half of the students under the present system furnish but poor mental diet.

Why cannot all of the good features of the elective system be better attained by permitting each young man to choose in general the object or purpose for which he wishes to educate himself, and then leave the entire course of studies to the one or more professors in the faculty who are especially fitted to plan a complete and logical course in the chosen field? Let the young man say where he wishes to go, and let the faculty tell him the road he is to travel to get there.

As to the object of college life, some boys are sent to the university to learn how to mingle with men, and to form friendships which shall prove useful and agreeable in after life. Some go there to amuse themselves, and some to get the standing given by a college degree.

Something can be said for each of these objects. Is not the true object of all education, however, that of training boys to be successful men? I mean men successful in the broadest sense, not merely successful money getters. Successful, first in developing their own characters, and second, in doing their full share of the world's work.

Young men should not come to college mainly to get book learning or a wide knowledge of facts. The successful men of our acquaintance are, generally speaking, neither learned nor men of great intellect. They are men, first of all, possessed with an earnest purpose. They have a certain all-round poise or balance called common sense. They have acquired through long training those habits both mental and physical which make them masters over themselves; and at all times they have the firm determination to pay the price for success in hard work and self-denial.

It is singleness and earnestness of purpose that constitutes the great motive power back of most successful men, and it is a notable fact that the moment a young man becomes animated with such a purpose, that moment he ceases to believe in the elective system, and in the loose college discipline.

In all earnest enterprises which the students themselves manage, they throw the elective system to the winds, and adopt methods and a discipline quite as rigid as those prevailing in the commercial and industrial world.

The boy who joins the football squad is given no sixty cuts a season, nor is he allowed to choose what he will do. He does just what someone else tells him to do, and does it at the time and in the manner he is told, and one or two lapses from training rules are sufficient cause for expulsion from the team or the crew.

I say in all seriousness that were it not for a certain trickiness and a low professional spirit which has come to be a part of the game, I should look upon football and the training received in athletics as one of the most useful elements in a college course, for two reasons: first, because in it they are actuated by a truly serious purpose; and second, because they are there given not the elective idea of doing what they want to, but co-operation, and co-operation of the same general character which they will be called upon to practice in after life.

Is not the greatest problem in university life, then, how to animate the students with an earnest, logical purpose?

In facing this question I would call attention to one class of young men who are almost universally imbued with such a purpose; namely, those who, through necessity or otherwise, have come into close contact and direct competition with men working for a living. These young men acquire a truly earnest purpose. They see the reality of life, they have a strong foretaste of the struggle ahead of them, and they come to the university with a determination to get something practical from the college training which they can use later in their competition with men.

They are in great demand after graduating, and as a class make themselves useful almost from the day that they start in to work.

Neither their earnestness of purpose, however, nor their immediate usefulness, comes from any technical knowledge which they have acquired while working outside of the university, but rather from having early brought home to them the nature of the great problem they must face after graduating. Nothing but contact with work and actual compe-

tition with men struggling for a living will teach them this. It cannot be theorized over or lectured upon, or taught in the school workshop or laboratory.

I look upon this actual work and competition with men working for a living as of such great value in developing earnestness of purpose that it would seem to me time well spent for each student, say, at the end of the Freshman year, to be handed over by the university for a period of six months to some commercial, engineering or manufacturing establishment; there to work as an employee at whatever job is given him, either manual or other work. He should have the same hours and be under the same discipline as all other employees, and should receive no favors. Moreover, he should be obliged to stay even a longer time than six months unless he has in the meantime given satisfaction to his employers.

I believe that there would be but little difficulty in obtaining the co-operation of our business and manufacturing establishments in carrying out this plan, and the University of Pennsylvania, situated as it is in the foremost manufacturing city in this country, would have an especially good opportunity to inaugurate it.

My belief in the benefits to be derived from doing practical, every-day work early in the college course, is not the result of a theory. It is founded upon close observation and study of young men who have had this experience, and also upon a vivid remembrance of breakfasting each morning at five-thirty and starting to sweep the floor of a pattern shop as an apprentice some thirty-two years ago, after having spent several years in preparing for Harvard College. The contrast between the two occupations was great, but I look back upon the first six months of my apprenticeship as a patternmaker as, on the whole, the most valuable part of my education. Not that I gained much knowledge during that time, nor did I ever become a very good patternmaker; but the awakening as to the reality and seriousness of life was complete, and, I believe, of great value.

Unfortunately, laboratory or even shop work in the University, useful as they are, do not serve at all the same purpose, since the young man is surrounded there by other students and professors, and lacks the actual competition of men working for a living. He does not learn at college that on the whole the ordinary mechanics, and even poorly educated workmen, are naturally about as smart as he is, and that his best way to rise above them lies in getting his mind more thoroughly trained than theirs, and in learning things they do not know. All of this should be taught him through six months' contact with workingmen.

Let me repeat, in conclusion, that our college graduates are the best-picked body of men in the community. Yet I believe that it is possible to so train young men that they will be useful to their employers almost from the day that they leave college; so that they will be reasonably satisfied with their new work, instead of discontented; and to place them, upon graduating, one or two years nearer success than they now are; and that this can best be accomplished by giving them an earnest purpose through six months' contact early in their college life with men working for a living; by rigidly prescribing a course of studies carefully and logically selected, and with some definite object in view, and by subjecting them to a discipline comparable with that adopted by the rest of the world.

Philadelphia possesses and is proud of the most notable group of medical schools in this country, and among these that of the University of Pennsylvania unquestionably stands first.

The Philadelphia lawyer has been proverbial for his knowledge and shrewdness for more than a century, and this reputation can be traced largely to the fundamental training given in the law school of the University of Pennsylvania.

Philadelphia is the center of the largest and most diversified group of engineering and manufacturing enterprises in this country. The Engineering Schools of the University of Pennsylvania already stand high; but it seems to me that the opportunity lies open to them even more than to their famous medical and law schools to stand at the very top. This magnificent building, equipped as it is with the latest and best of everything, is the first and a great step toward this end. But, after all, your largest possibility, and one which does not exist for and cannot be created by any other American university, lies in the opportunity for bringing your students into close touch and personal contact with the men who are working in and managing the great industrial establishments of Philadelphia.

THE LARGEST LOCOMOTIVE IN THE WORLD.*

Thomas F. Crawford.

James J. Hill, president of the Great Northern Railway Line, and commonly known as the "Empire Builder of the Northwest," has long been noted as a seeker of things that are big. His ships are the biggest on the Pacific Ocean, his ore docks at Allouez are the largest in the world, as is also his grain elevator at Superior, Wisconsin; and now he is the possessor of the five largest locomotives ever constructed.

These were built by the Baldwin Locomotive Works, of Philadelphia, during the past summer, and represent the most modern ideas and practice employed in this or any other country at the present time. As a machine the locomotive has always been of interest to the layman, as well as the mechanic, and this latest product is of more than ordinary interest, owing to the fact that it illustrates a radical departure in locomotive building that is as yet in its infancy as far as this part of the world is concerned; namely, the "Articulated (Mallet) Compound" design.

Scarcely a railroad in this country can boast of a line that does not require a pusher engine, at some point, in order to get the regulation freight trains up the grades. If "pusher engines" are not used it is necessary to double over, by cutting the train in two, so that in either case much valuable time is lost and extra expense incurred. This condition is more decided in the West and Northwest, where the Rocky and Cascade mountains form an almost impassable barrier. Often it is necessary to double head in front and have a pusher behind in order to move a train that on a level track would require but one heavy freight engine. This fact has long been troubling the officials of every important road, more especially where the competition is heavy and any slight extra expense immediately affects the dividend-paying power of the road.

Locomotive designers have spent much time in working up compound and other steam-saving devices, but the problem remained unsolved; until finally they were compelled to take up what had been used in foreign countries for many years, at last bringing the Mallet Compound idea to the United States. A little more than two years ago the American Locomotive Company brought out the first American adaptation of the principle, in a locomotive built for the Baltimore and Ohio R. R. This locomotive was at that time the largest ever built and its performance has been watched with utmost interest by motive power officials in every section of the United States. Much literature has been published regarding the work that this engine has done on the heavy grades over the mountains near Cumberland, Maryland, and as a general rule the reports have been exceedingly favorable, justifying the introduction of such a type in this country.

*Reprinted from the "Sibley Journal of Engineering," Cornell University.

The locomotive itself is essentially two separate machines operating under one boiler; one engine working high-pressure steam direct from the boiler; and the other working low pressure as exhausted from the high pressure. The advantage of this independent compounding is readily seen, for the enormous weight of the boiler and other parts is distributed over an extremely large driving wheel base which in itself means increased power. The tractive power or ability of a locomotive to pull depends entirely upon the adhesion of the wheels to the rail, and consequently the power is directly governed by the weight supported by the driving wheels.

With ordinary single-expansion or compound locomotives there is a certain limit; cylinder diameter may be enlarged and boiler pressure increased above this, but all is wasted for the greater power simply causes the driving wheels to slip violently without moving ahead as the tractive power now exceeds the adhesion. With the Mallet Compound, however, this is different for the great weight is supported by many driving wheels extending over a large distance, which permits of extra large cylinders, in fact the tractive power of this type is almost double that of the ordinary "Consolidation" type that is now almost universally used for freight service.

The following formula for simple and compound locomotives, published by the Baldwin Locomotive Works, will show clearly the relation of tractive power to cylinder diameter and boiler pressure. It also shows that the smaller in diameter the wheels the greater the power; this explains the small wheels usually found on freight locomotives. In this connection it is interesting to note that the locomotive is one of the few machines that becomes more powerful the more it wears, for with every mile of service the tires are worn to some extent, soon resulting in an appreciable reduction in diameter which results in increased tractive power, as will be seen from the formula:

$$\text{Tractive Power (simple eng.)} = \frac{C^2 \times S \times P}{D}$$

$$\text{Tractive power (compound eng.)} \left\{ \begin{array}{l} = \dfrac{C^2 \times S \times \frac{2}{3} P}{D} \\ \dfrac{c^2 \times S \times \frac{1}{4} P}{D} \end{array} \right.$$

C diameter of high-pressure cylinder in inches.

c diameter of low-pressure cylinder in inches.

S stroke of piston in inches.

P mean effective pressure in pounds (usually 85 per cent. boiler pressure).

D diameter of driving wheels in inches.

Another excellent feature of the Mallet design is the distribution of the strains in the rods, pins, etc., due to the fact that the power is transmitted to four crank pins instead of two, as in the ordinary locomotive. The American Balanced compound is another recent example of this distribution of strains. For sharp curves the Mallet type is also quite adaptable, owing to the short, rigid wheel base; in this case, 10 feet. At a first glance it would seem as if the whole boiler rode on one rigid frame, but such is not the case. Just in front of the high-pressure or middle pair of cylinders, the frame is joined together by means of a pin connection which allows the forward set of wheels to move freely as though they were merely a large truck. The locomotive in use on the B. & O. is said to have ridden easily on curves up to 22 degrees.

The high-pressure cylinder casting is bolted to the shell of the boiler but the low-pressure cylinders in front are simply connected to the frame, the weight being held up in front by a small truck wheel not found in the original B. & O. design. The weight of the front end of the boiler is transmitted to the frames by means of a sliding bearing or shoe, which is connected to the boiler and slips from side to side across the frame.

Another foreign feature on this engine, and now being introduced in this country, is the Walschaert Valve gear, which is located in plain sight outside the wheels. This motion is fast becoming popular and already has been adopted as standard by three of the leading trunk lines. With this type of engine it is almost a necessity, owing to the need of inside frame space for bracing and other features.

The Great Northern engines are all in use on the Cascade Mountains, where it has always been extremely difficult to move heavy freights. No records are as yet obtainable, but should the five locomotives now in service prove as successful as that operated on the B. & O., there is no reason why all lines operating through the mountain regions should not adopt the new idea. The mere saving in labor alone will amount to many dollars, for the Mallet will operate with one engineer and fireman and do the work of two engines, thus saving $8.50 per day or about $3,100 per year.

The following are the dimensions of this, the largest locomotive in the world:

Total weight of engine alone	355,000 lbs.
Total weight engine and tank	503,000 lbs.
Total length engine and tank	83 ft. 7¼ ins.
Diameter of cylinders	(H.P. 21½ ins.) (L.P. 33 ins)
Stroke of piston	32 ins.
Diameter of drivers	56 ins.
Diameter of boiler	84 ins.
Steam pressure	200 lbs.
Total heating surface	5700 sq. ft.
Total grate surface	78 sq. ft.
Number of tubes	442—2¼ ins. diameter
Tractive power	71,540 lbs.

POWER AND LIGHTING RATES OF THE JAMESTOWN EXPOSITION.

The rate for electric service at the Jamestown exposition, which will open at Hampton roads on April 26 of next year, are as follows:

Rates for Light Service.

100 kilowatt hours or less, 10 cents per kilowatt hour; 101 to 280 kilowatt hours, 9 cents per kilowatt hour; 281 to 625 kilowatt hours, 8 cents per kilowatt hour; 626 to 1,430 kilowatt hours, 7 cents per kilowatt hour; 1,431 and above kilowatt hours, 6 cents per kilowatt hour.

Rates for Power Service.

115 kilowatt hours or less, 9 cents per kilowatt hour; 116 to 360 kilowatt hours, 7 cents per kilowatt hour; 361 to 770 kilowatt hours, 6½ cents per kilowatt hour; 771 to 1,365 kilowatt hours, 5½ cents per kilowatt hour; 1,366 to 2,225 kilowatt hours, 4½ cents per kilowatt hour; 2,226 and above kilowatt hours, 4 cents per kilowatt hour.

The exposition company will make all necessary connections from the exposition service main to the main switch and fuses installed by the consumer, together with all necessary meters and apparatus for measuring the current consumed, at the consumer's expense. Alternating current at a frequency of 60 cycles and at approximately 110 volts will be furnished for lighting purposes on the entire ground. On the War-path direct current of the same voltage will be also available. For the power service direct current at approximately 500 volts will be furnished, but special arrangements may be made with the department of electricity for furnishing alternating current for small motors.

The rates above given are subject to a discount of ten per cent. for prompt payment, and are, of course, subject to the terms of any special contract which a consumer may execute.

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EDITORIAL.

The Cable and The Trolley

Mr. Andrew S. Hallidie, of San Francisco, invented and perfected the cable street railway system, as it was first introduced on Clay Street, in this city, more than a quarter of a century ago. While having been devised primarily for heavy grades, such as even today exist on many of San Francisco's principal streets, but a few years after the installation in the Pacific Coast city, the horse cars of Chicago were replaced by cable lines, although the streets of the latter city are remarkably level. The convenience of control and the adaptability of the cable for city streets was thus early recognized, and the original ideas of the inventor were extended to the general use of the cable for city street railway service.

During the next few years, the cable road was introduced in Cincinnati, Kansas City, Philadelphia, New York City and Washington, D. C., very nearly in the order named. Other small cities, principally on the Pacific Coast, such as Los Angeles, Oakland, San Jose and Seattle had in the meantime installed cable street railway systems.

From its first introduction in San Francisco in 1873, the cable road had a rapid and steady growth until about 1895. Near the latter date the total length of all of the lines in operation in San Francisco alone was about one hundred miles, many of the grades being in excess of 16 per cent. Probably in the aggregate there were in the United States at that time between seven and eight hundred miles of cable street railway in operation.

New York City, between 1895 and 1899, after practically every other city had either abandoned cable railway extensions or actually replaced the old cable lines with the electric trolley, built and put in operation more than fifty miles of cable street railway lines. But a few years elapsed, however, before the first city in the United States began to abandon its cable roads in favor of more rapid transportation systems.

For the largest cities on the busiest and most crowded thoroughfares, the cable car has many advantages. The speed is practically fixed, no matter what the grade of the track or the load on the car may be, but this speed can rarely be made to exceed twelve miles an hour, which practically excludes the cable for suburban or residence traffic.

There can be no question that the cable road, even today, would be increasing in popularity and new lines under construction if it were not for the introduction and general development of the electric street railway system, which is almost exclusively the trolley system. While in a different way than was the case in other cities, San Francisco has had an opportunity since last April of comparing the efficiency of the electric street car and its predecessor, the cable car. Due, it must be admitted, to abnormal conditions, there is today in San Francisco but a very few miles of cable road in operation. Beginning with approximately ten years ago, all new street railway construction in San Francisco was of the electric trolley system, and the very rapid growth of the suburbs of San Francisco is undoubtedly due to the extensive introduction of the electric trolley system.

The adaptability of the trolley to San Francisco's principal streets is a matter of great importance. When the city is rebuilt, would it be advisable to have the electric trolley system in use on such thoroughfares as Market St., Van Ness Ave., Kearny St., Sutter St., and in fact all of the business streets in the retail and wholesale districts? It is quite certain that the congested traffic, which seems unavoidable at the present time, would be even more serious than it is were it not for the substitution of the electric trolley system for the old cable lines. The San Francisco of the future, however, should undoubtedly be a city without down-town surface roads, particularly on its principal thoroughfares, and during the few years of reconstruction it may be advisable to continue the use of the electric trolley, rather than go back to the old cable system.

For outlying districts, there can be no question that the overhead electric trolley is the only system which can be practically installed, taking the cost of construction and speed requirements into consideration. For the congested portions of the city, the entire elimination of the surface roads would undoubtedly be preferable to even the use of the underground conduit electric system.

CORN HARVESTING MACHINERY.

The United States Department of Agriculture has recently issued Bulletin No. 173, entitled "The Evolution of Corn Harvesting Machinery," by C. J. Zintheo.

In the principal corn-growing regions of the United States, as a rule only the grain is harvested, the stalks being left in the field to be eaten by live stock, or raked and burned. It is estimated that in this way nearly one-half the food value of the corn plant is wasted. This bulletin describes the various machines which have been developed for harvesting the corn plant and preparing it for stock feed. It gives statements of cost, the length of service which may be expected under ordinary conditions, and the work which can be done with the various machines.

Application for this bulletin should be made to the Director of the Office of Experiment Stations, Washington, D. C.

TRADE CATALOGUES.

Pass & Seymour, Inc., Solvay, N. Y., have gotten out an unusually attractive little booklet telling about P. & S. incandescent lamp sockets. The covers are a bright red and are embossed in black and gold, producing a striking effect.

The H. W. Johns-Manville Co., which has branches in all large cities, points out the merits of its "Transite" asbestos doors in a small folder. Transite is a fireproof sheathing made principally of asbestos fibre, and may be cut, nailed or screwed very much the same as ordinary lumber. The doors are used in connection with fireproof walls for protection from high-tension transformers and switches.

The Crocker-Wheeler Company, of Ampere, N. J., is distributing a 1907 calendar, showing a view, printed in colors, of the main office and works of the company, where its electric motors, generators, transformers, etc., are designed and built. The calendar is a good example of lithographic work, and gives an impression of the magnitude and attractive surroundings of the Crocker-Wheeler works.

A list of electrical fittings, which have been examined and approved by the Underwriters' National Electrical Association, is given in the 1906 edition of "Electrocraft," published by the Electrocraft Publishing Co., Detroit, Mich. This is a 185-page catalogue containing illustrations, with name and address of manufacturer, of attachment plugs, bushings, conduits, cabinets, switches, fuses, sockets and other electrical fittings.

"The Booster" for December, published quarterly by the Co-operative Electrical Development Association, contains some real live talk tending to stir the central station manager to a realization that there is much new business to be obtained by energetic advertising and soliciting. There is also an outline of the good work already accomplished by the Association in its endeavors to promote the sale of electricity for commercial and domestic purposes.

The possible use of induction motors for a wide range of industrial purposes is admirably shown in Bulletin No. 1040 (revised edition), recently issued by the Electrical Department of the Allis-Chalmers Co. Types for the various uses are shown with methods of installing same. Dimension data for standard sizes is also given.

PERSONAL.

Mr. Harry C. Rice, vice-president of the General Incandescent Lamp Co., of Cleveland, has favored the Coast with a visit in the interest of the trade. This company is now engaged in the manufacture of incandescent lamps exclusively.

Mr. Rice will visit Los Angeles and other Coast cities before returning east.

"THE ILLUMINATING ENGINEER,"

published by the Illuminating Engineering Pub. Co., announces the removal of its publication offices from 25 Broad Street to larger and more centrally located quarters at 12 West 40th Street, opposite New York Public Library.

A SUCCESSFUL TEST.

Professor Durand, of Stanford University, recently made a test of the steam power plant of the Home Gas and Electric Company, of Redlands, California. This test was to determine the forfeit or bonus, as the contractor guaranteed the kilowatt output at the switchboard per barrel of fuel oil. This guarantee was exceptionally high, but it is reported that the results have so far exceeded the guarantee as to set a new standard in the economical development of power with oil as a fuel.

This plant was designed and built by The Tracy Engineering Company, who make a specialty of economy power plants.

AN UNIQUE NATURAL PRODUCT.

One of Nature's most wonderful and unique products is Asbestos, a material which, in spite of its extensive use, is comparatively unknown to the general public. Prior to 1850, it was looked upon principally as a curiosity, although Charlemagne (Roman Emperor from 800 to 814 A. D.) is said to have had a table cloth made of Asbestos, which he cleaned by throwing into fire.

There are two varieties of commercial asbestos, known as Amphibole and Chrysotile. The former is used only to a comparatively small extent, as the fibres are short and without tensile strength, and are therefore not suitable for manufacturing many of the asbestos products. Amphibole is used to some extent in cements, but is not well adapted even for that purpose. Chrysotile, on the other hand, has a strong and silky fibre, which adapts it for such materials as asbestos fabrics, household utensils, theater curtains, clothing for firemen, etc.

In Germany, asbestos is known as steinflachs (stone flax) and the miners of Quebec give it quite as expressive a name—pierre cotton (cotton stone).

Asbestos is mined in open pits, similar to stone quarries, and although it is found in all parts of the world, the mines in Quebec, Canada, are the most famous, yielding about 85 per cent. of the world's supply of chrysotile. Probably the largest of these mines is that owned by the H. W. Johns-Manville Co., of New York. In 1879 the output of the Quebec mines was 300 tons, which has steadily increased, year by year, to 50,000 tons in 1905.

SEEING BY ELECTRICITY.

Almost at the same time two different inventors in different places have announced their success with electrical devices for seeing at a distance. They are J. B. Fowler and William H. Tompson. In Fowler's device four wires are required to accomplish the combined effect of distant vision and hearing. Details of the operation are withheld, however, on the plea of getting out a patent. Each inventor has adopted the name "Televue."

GREAT WATER POWER PROJECT.

Former Governor Herrick, of Ohio, and Thomas F. Walsh, of Denver, have formed a $9,000,000 syndicate for the purpose of harnessing the mountain streams of the Rockies for long-distance transmission, so as to revolutionize western industries. John Hayes Hammond has been employed as chief engineer. Herrick predicts that in ten years every railroad crossing the mountains will use electrical power generated by falling water.

AN AMERICAN'S IMPRESSION OF EUROPE.

In a letter which we have just received from Berlin, Mr. E. N. Percy comments vigorously on the national characteristics of the leading European countries, taking the point of view of the American engineer. Mr. Percy writes as follows:

"The French are not great theorists, but they like to construct wonderful and delicate mechanisms. The French workman takes great pride in the exquisiteness of a piece of work, spending more time, for instance, on the appearance and finish of an automobile engine than on its strength and hardiness. Their machinery looks as though it had been designed by a lacemaker or an artist, rather than by an engineer. They are always making experimental machinery on a large and costly scale. For instance, they recently made a huge turbine air compressor run by a Parson's turbine. The assumptions were evidently in error, for it turned out to have a very low efficiency. This would have been impossible in Germany; for if the efficiency could not have been forecast by mathematics, the turbine would never have been built.

"England is an intensely practical nation, and one finds few highly technical men. They have no patience with analysis; they want to 'do' things. For this reason English methods are a bit backward. Men seldom work as hard here as in America. They count on making their jobs last as long as possible, and resent the influx of any labor-saving machinery whatever. They drink more than is really healthful, and have numerous holidays and labor troubles interfere with the execution of work. There is nothing active, new or progressive about the average English shop; there is the same dull routine.

"The Scotch shops are very different. Here we see good, hard-working mechanics and men who know their business thoroughly; but they are too conservative, and hence there is comparatively little encouragement for new ideas. For that matter, outside of America no country offers any great financial inducements for the introduction of new methods. Japan is very progressive, but foreigners can not realize anything on their inventions as there is no patent protection in this country.

"In Germany we find education to be a colossal monument of theory. On gràduation from the gymnasium a young man is about twenty-three or four years old; he has a high-school education and is just ready to enter the technical school. After from five to seven years here he is thrown out into the world to make his living—an inefficient man of thirty years or more and the best part of his life gone. He is, if he has been a conscientious student, baldheaded, weak-eyed, without personality, knows nothing of the world nor of meeting people, knows nothing of business nor many things which are familiar to an American boy ten years his junior, who is taking the same course. For instance, here a graduate in mechanical engineering knows nothing whatever about surveying or foundation work. He has never taken an outdoor measurement. The civil engineer knows all about the chemistry of concrete and cement, yet he hears not one word about the machinery for making these. He starts to work for $25.00 to $30.00 a month, if he can get a job. Young men are trusted with nothing here. The writer (who boasts about thirty years) had some difficulty in convincing a manufacturer that he actually had been trusted to buy and sell machinery for an American firm.

"Not long ago it was desirable to determine the size and shape of a steam turbine nozzle. Acres of paper had been covered with calculations and acres more were to be covered. A professor arrived from America. He arranged a jet of steam so as to discharge into a vacuum, photographed the jet and measured it, and the problem was solved while German eyes looked on with astonishment.

"At the universities there is no fellowship with the professors. Their dignity and the social pedestal upon which they stand prevents all intercourse. There is no student body organization and no college life, if the duelling and drinking corps be excepted.

"Physicians and chemists constitute Germany's prize technical men. As to physicians, the writer seriously believes, from knowledge gained through personal acquaintance with most members of the American Physicians' Club in Berlin, that America's medical men are just as wise and far more skillful as surgeons. They come here because they are ignorant of existing conditions in order to obtain the prestige and knowledge supposed to be available. Another inducement is that there is so much material here to practice on.

"In Germany, no matter what a physician does to a patient, there is no redress by law. There is an immense number of poor people who receive free treatment from physicians making their living entirely by teaching others. They are often cruel to these patients; cases have come to the writer's attention of operations performed without the use of anesthetics, as well as operations in the nose with instruments that were too large, thus causing pain and injury for the sake of observing the scientific result. Dying patients are neglected and physicians talk in their hearing of the probable results of the post-mortem. This is not said out of malice, but to show that the nation is scientific above everything, even the heart.

"The railroads here are owned by the government. They are said to pay an immense revenue and to be self-supporting; and strikes are unknown. However, if this is a sample of government ownership, the writer does not care to see it established in the states. The railroad civil engineering specialist is almost unknown here, and a ride over the road gives one no reason to doubt the statement. The road beds are elevated in nearly all cities, and the block system is universal, but the rails are light and the road bed rough. The stations are all very complete, and the locomotives are economical, with patent valve gears, but are light and slow, there are no fast trains; the fastest not making 50 miles per hour, and the rolling and pitching can only be equalled by some of our Colorado railroads. Locals are unbearably slow, making ten or fifteen miles per hour. All cars are light, and have but two trucks each. Also, the short cars and all freight cars have only four wheels, all told—like a toy street car. Their largest freight car is smaller than a furniture van in San Francisco.

"All of the employees are uniformed, and military discipline prevails. The engineer does not wear overalls, but a gorgeous uniform; and the magnificently accoutred conductor is not a paragon of virtue, but a mere man, who for twenty cents will reverse the sign on the door of your compartment, changing it to first class, which indicates that no one else can come in. First class in this country is a privilege. It means that you have the place to yourself. In the second class compartment, the public can enter until it is full, although it is a duplicate of the first-class compartment. A man can do wonders with a few cigars. By handing them around you make friends; by smoking them, you secure undisputed possession of the compartment; at least, that was the writer's experience. It might be well to add that he cannot afford to smoke the brand he keeps for his friends; hence the above judicious use of difference in brand.

"All power-developing machinery must be the most efficient possible, as fuel is very expensive, and the conditions of the country are such that the capitalist is satisfied with a small, sure interest on a large investment. The principal steam turbines in use are the Stumpf, made by the local 'Allgemeine Electrische Gesellschaft,' and the Sulzer turbine, made by that well-known firm.

"A great deal of American tool machinery is imported here. There is a great field for labor-saving machinery, and for such things as we can manufacture at competitive prices. Germany does not produce enough to support herself, so she is preparing to market her skill. Germany will not surpass nor even equal us in originality, any more than an old man can surpass a young man; nor can she produce what she does not have; but Germany is persistent and never takes her eye off the goal. She will surpass and pass us in manufactures (even with our machinery); she will get our foreign market, because we are now neglecting it; she will excel us on the seas, because she aims to become a sea power commercially. Among some of the brightest men in the world are Germany's statesmen and her Emperor.

"She stands at the head of the world in the manufacture of gas engines, and the largest firms in our country are manufacturing these from German patents. The Koerting and Nurnberg are examples, also the Diesel, the Mietz and Wiess. On the other hand, the slowness of the country in many ways is discouraging to those few live heads who would awaken it. Every day nearly every bank, business house, and shop in the country closes down from one o'clock until three or four, and one can transact no business. All workmen have their tea or beer several times a day, and with their slow methods, their holidays, frequent beers and refreshments the German workman accomplishes less in his day of twelve or fourteen hours than the American workman.

"The German automobiles are among the best in the world, but they cost far more than the American, notwithstanding that labor is cheaper. They produce a car that runs easily and very efficiently with a small engine. We put in an engine that burns more oil, but we put in a vaporizer that uses crude distillate at one-fourth the price of gasoline, an idea which the German never thought of.

"The German engineers say that we are not scientific, but money mad. One of them said that he worked with a pure scientific interest, and would not be swayed from his work by any mere monetary consideration. A fine position was offered him in America, at a greater salary, but with no scientific opportunity whatever. There is a vacancy here now for some man of scientific tastes who does not want too much money. (The position is still vacant.) We may be money mad, but I have seen the cause of our madness curve many a Teuton back. Money will not make a German hurry for the simple reason that it is impossible for him to hurry about anything; hence it is not strange that he does not run for it; but the writer has seen the porter of an engineering plant disobey his master's orders, neglect his duties, and take the writer through the plant by byways, and tire himself out with anxiety because twenty cents of good American money lay in his pocket and twenty more were to come. The writer has been in China, Japan, Honolulu, France, Canada, Belgium, Holland and other countries, and has yet to see a country that will not fall over itself to get hold of an American dollar.

"A man cannot get a position in Germany, except he be very well educated. The Royal Technical School in Charlottenburg, a suburb of Berlin, stands at the head of Germany's technical institutions. In this country may be found many technical schools of all kinds, but this one is acknowledged the best theoretical institute of technology in the world. Here are Professors Riedler, Stumpf, Josse and others who are famous all over the world. Riedler is known for his compressors and express pumps; Stumpf for his steam turbine work in Chicago; and Josse for his waste heat engine, actually constructed and successfully running in the school laboratory. Riedler was the original designer of the Nurnberg gas engine. At this school also are the men who design a large part of the German Navy and the passenger steamers. The Kaiser Wilhelm der Grosse was designed here.

"Here are conducted experiments in gas turbines, wireless telegraphy and other scientific subjects. About four thousand students can be accommodated, and the place includes many interesting features. The Kaiser comes here occasionally.

"Certainly, Germany excels in that class of machinery requiring great theoretical investigation and careful experimental construction. This would and does include steam turbines, centrifugal pumps, water turbines, gas turbines, turbine air compressors, gas engines, gas producers, waste heat engines, super heaters, etc."

THE OPERATION OF ALTERNATING CURRENT GENERATORS.*

Electrical machinery which has been exposed to a low temperature, should not be unpacked until it has reached the temperature of the surrounding air, as otherwise a film of moisture may form on the cold surfaces due to condensation. Alternators, particularly, should be dried out by short-circuiting the armature terminals and running the machine with a low field excitation sufficient to circulate in the armature current about 25 per cent greater than normal full load current. An armature should be used to indicate the current, and the machine run until it has become thoroughly warmed up and until all moisture is evaporated.

Before an alternator, not intended to be operated in parallel with other machines, is started, one should see that the oil rings are revolving freely, that all resistance in both exciter and alternator field rheostats is cut in, and that both field and main switches are open. The alternator and exciter should be brought up to speed gradually, and resistance in the exciter field cut out until the exciter pressure is up to its normal value. The field switch of the alternator can then be closed with all resistance in, so that full voltage will not be generated in the windings. In case the machine is being started for the first time, it should be allowed to run for an hour or two at low voltage and then the voltage gradually increased until it reaches normal; the load can then be thrown on. As the load increases it will be necessary to cut out some resistance in the field circuit in order to maintain full voltage, and if the load on the alternator is inductive a larger amount of resistance must be cut out than with a non-inductive load. On light loads comparatively small field excitation is required, and it is advisable to run the exciter at rather low voltage and avoid wasting so much power in the field rheostat, provided the exciter voltage is not made low enough to render the operation unstable or cause sparking at the brushes, and that the exciter is not used for exciting other alternators.

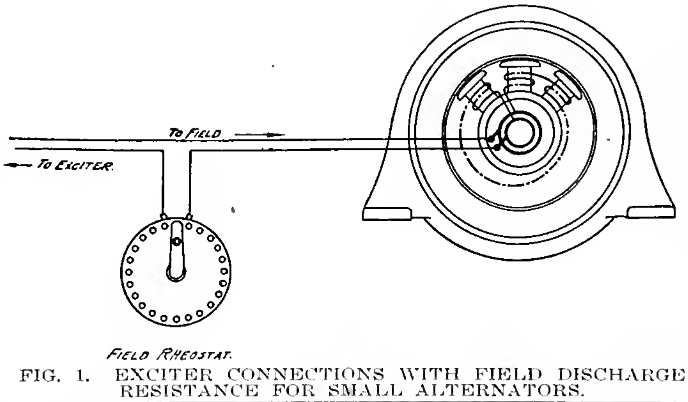


FIG. 1. EXCITER CONNECTIONS WITH FIELD DISCHARGE RESISTANCE FOR SMALL ALTERNATORS.

(*The installation of alternating current generators was discussed in the January 5th issue of the "Journal." The information given in the present article, as well as that contained in the preceding one, was very kindly supplied by the Allis-Chalmers Co.—Ed.)

To shut down an alternator running by itself, first cut in resistance in the field, thus lowering the voltage. Then open the main switch and finally the field switch of the alternator. The alternator field circuit should not be opened when full current is flowing, because the high induced E. M. F. caused thereby may be sufficient to break down the field insulation. With most large machines of the Allis-Chalmers Co. a grid resistance is connected to the field switch so that in case the latter is opened the resistance is first connected across the field circuit, thus forming a path through which the induced current can flow and prevent any abnormal rise in E. M. F. Fig. 1 shows the exciter connections for small machines, and Fig. 2 for larger alternators where a grid discharge resistance is used.

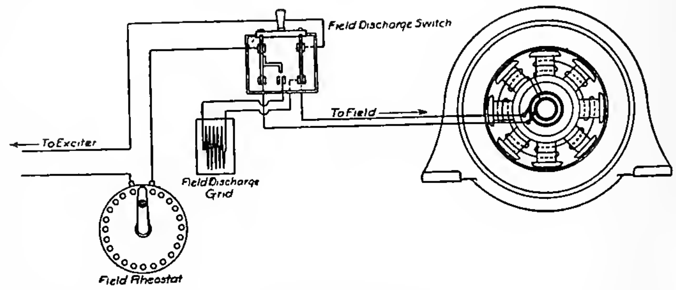


FIG. 2. EXCITER CONNECTIONS WITH GRID DISCHARGE RESISTANCE.

When two or more alternators are run in parallel there are certain conditions that must be met in order to secure satisfactory operation. These are:

(a.) The machine must be in synchronism. That is, the frequency must be the same for each, and the E. M. F.'s of the different machines must be in phase.

(b.) The E. M. F.'s must be approximately equal.

(c.) In order to secure proper division of the load under changes in load conditions, the speed regulation of the prime movers must be alike.

(d.) To prevent periodic cross currents between machines the variations in angular velocity of the prime movers must be kept within certain limits. In water-wheel or steam-turbine driven units the angular velocity is uniform, but with reciprocating engine units there may be trouble due to periodic variation if the engine fly-wheels are not heavy enough.

With belted alternators it is very important that the pulleys be proportioned so as to make the speeds of the alternators such that they will give exactly the same frequency; if all the machines have the same number of poles their speeds must be exactly alike. If the pulleys are not of the proper size there will be excessive belt slippage or exchange of cross currents between the machines, thus causing fluctuations in voltage.

With engine-driven alternators the speed can be varied by adjusting the governor, and there will be no trouble from cross currents, provided the angular velocities of the engines do not vary too much, and the engine governors act properly.

When two alternators are running in parallel their output (actual power) depends on the amount of power supplied by their prime movers. For example, suppose two engine-driven machines are running in parallel on a certain load, and that each is taking half of the load. When the load increases there is a tendency for the speed to drop slightly, and in order for the engine governors to act and admit more steam there must be a slight drop in speed. Now, the two alternators must always run in synchronism, or at the same speed, assuming the number of poles to be alike, and if the drop in speed does not result in an equal increase in the steam admission of each engine, one alternator will be supplied with more power than the other, and the load will become unequally divided. Changing the field excitation of the slightly loaded machine will not remedy matters (as with direct current generators where the generators do not have to run in synchronism and have independent speeds). The only effect of changing the field excitation is to make a wattless current circulate between the two alternators, the actual amount of power supplied by each remaining the same. The only way to increase the steam admission is by adjusting the engine governor, and to secure equal division of load under all conditions the change in speed for a given change in load must be alike for each engine. When two or more alternators are run in parallel it is advisable to have an indicating wattmeter on each machine, so that the actual load will be known. In case wattmeters are not provided the load on each should be adjusted so that the sum of the currents as indicated by the machine ammeters will be a minimum for a given total current supplied to the line. If the sum of the machine currents is much in excess of the line current it shows that a wattless current is circulating between the machines.

Synchronizing of Alternators.

The condition of synchronism is usually indicated either by incandescent lamps, or by a synchronism indicator or synchroscope, the latter now being used in most large installations. A synchroscope gives more accurate indications than lamps, and has the additional advantage of showing whether the machine is coming into or going out of phase, and how much it is out of phase.

Fig. 3 shows diagrammatically the connections for synchronizing lamps. Two small transformers A and B have their primaries connected to the same phase of each generator. The secondaries C and D are connected in series through a plug or switch p, and lamps KL. Assuming that corresponding terminals of the primaries are connected to corresponding lines on each machine, and that the two transformers are alike in every particular, corresponding secondary terminals will, at any given instant, have the same polarity when the two machines are in phase. When plug p is inserted, secondary terminals of opposite polarity are connected together; hence the two secondary E. M. F.'s are in series and aid each other in forcing current through lamps KL, which are, therefore, bright at synchronism. It may happen that the transformers are not wound exactly alike

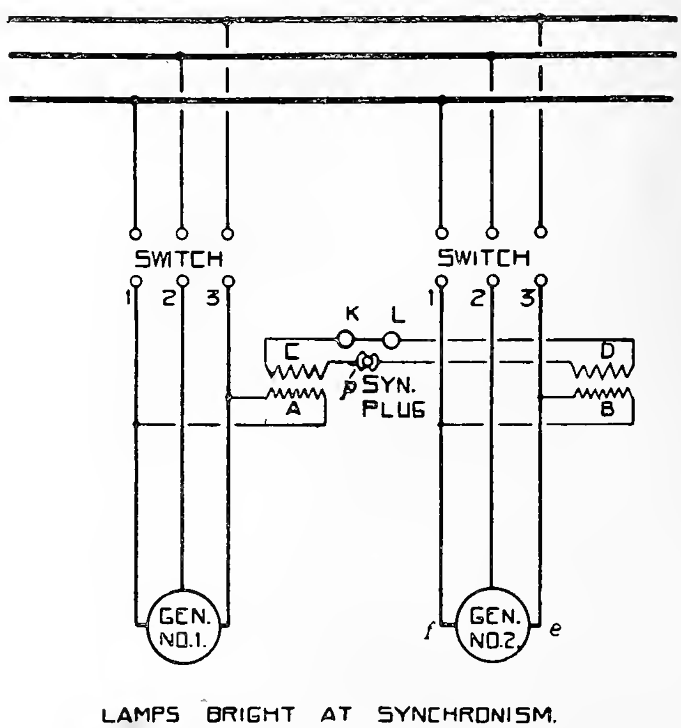


FIG. 3. CONNECTIONS FOR SYNCHRONIZING LAMPS.

or that the connections have become confused; it is always advisable, therefore, to test the connections to make sure that the lamps are light or dark at synchronism. To test the connections in Fig. 3, disconnect B from Gen. No. 2 and transfer the connections, without changing their relative position, to lines 1 and 3 of Gen. No. 1; A and B will then be connected to the same lines, and if the lamps are bright, they will also be bright at synchronism where B is connected to Gen. No. 2 as shown. If dark lamps are preferred, either the primary or secondary connections of one transformer must be reversed.

Another method of testing the connections is to leave the transformer connections as they are and disconnect the main leads (e. f.) on Gen. No. 2. Both main generator switches are then closed, thus connecting both transformers A and B to Gen. No. 1. In synchronizing, bright lamps are to be preferred to dark ones.

When a polyphase alternator is first connected up it is very important to see that all of its phases correspond with those of the bus-bars; if one phase only of a three-phase machine is correct, it does not follow that the other two are correct also. Two of the phases should be tested at the same time by using a pair of auxiliary transformers in addition to the regular synchronizing transformers AB, Fig 4. Transformer A is connected to the bus-bars, and B to the generator. A second pair of transformers CD is connected to one of the other phases, the connections in each case being such that the lamps are bright at synchronism. The connect'ons should be tested as described above to make sure that the polarity of the transformers is correct. With

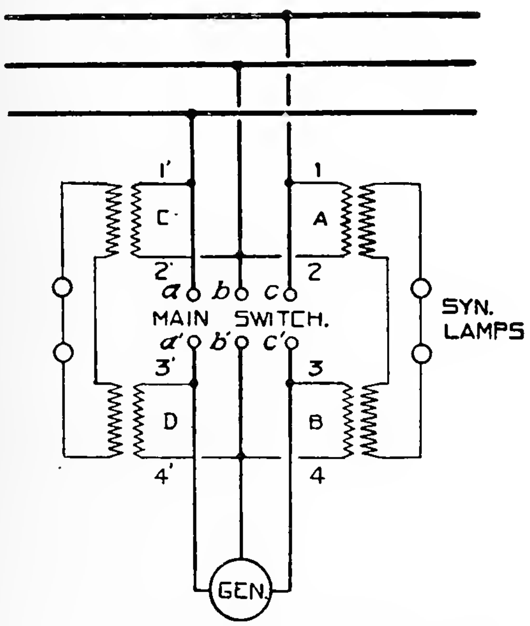


FIG. 4. CONNECTIONS FOR TESTING SYNCHRONISM OF POLYPHASE ALTENATOR.

the main switch open and with the generator running at full voltage, both sets of synchronizing lamps should pulsate together. If they do not do so the leads from the generator are incorrectly connected to the generator terminals, and should be interchanged so as to make the lamps pulsate together. After this test has been made, to insure that terminals a, b, c, connected to the bus-bars correspond to a', b', c', connected to the generator, the temporary transformers CD can be removed.

When a belted alternator is to be thrown in parallel with another machine, first bring the incoming generator up to speed and adjust the voltage until it is approximately the same as that of the bus-bars. Adjust the speed until the beats of the synchronizing lamps become very slow, say one beat in two or three seconds, or until the pointer of the synchroscope is moving very slowly. Close the main switch when the lamps indicate synchronism (lights light or dark depending on the connections), or when the pointer of the synchroscope is over the central point or slightly ahead of it. Adjust the field excitation and see that the alternator is supplied with enough power to make it carry its share of the load. In case a number of belted alternators are driven from a common line shaft, the belt of the incoming machine should be slackened, thus introducing enough slip to allow the machine to be synchronized. After the alternator is in step, the belt can be tightened and the load gradually applied.

With engine-driven alternators the incoming machine should be given only a small amount of steam until after it is synchronized. The load can then be taken up by admitting more steam. In large plants the engine governor is usually arranged so that it can be controlled electrically from the switchboard and the steam admission varied as desired. If the governor cannot be so controlled the steam admission can be regulated at the throttle. Water-wheel governors are also frequently provided with an electrical control device; if not, the gate opening must be controlled by hand to synchronize the machine and adjust the load.

When machines are operated in parallel and one is to be shut down, first reduce the load by throttling the engine or slackening the belt. Then open the main switch. Cut in resistance in the field of the alternator to reduce the field current, and open the field switch.

General Care of Alternators.

On account of not having a commutator, alternators are on the whole easier to keep in good running order than direct-current machines. At the same time they must be properly attended to. It must be remembered that they frequently generate much higher pressure than direct-current machines, and there is all the more necessity for keeping them perfectly clean. No dirt, copper or carbon dust should be allowed to accumulate on or near the windings, and in plants sufficiently large to warrant the expense, it is advisable to install a compressed air system so that all dirt can be blown out of the corners not otherwise easily reached. It is also advisable to give the armature coils and connections a coat of insulating varnish occasionally.

The collector rings should be kept lubricated with a small quantity of vaseline applied with a cloth, and the brushes should make good contact with the rings. The field circuit ought never to be opened suddenly while the current is flowing, and both main and field switches should always be habitually open when the machine is not running.

Care should be taken not to connect alternators in parallel when they are out of synchronism, as the excessive rush of current throws heavy strains on the engines and generators and may cause considerable damage.

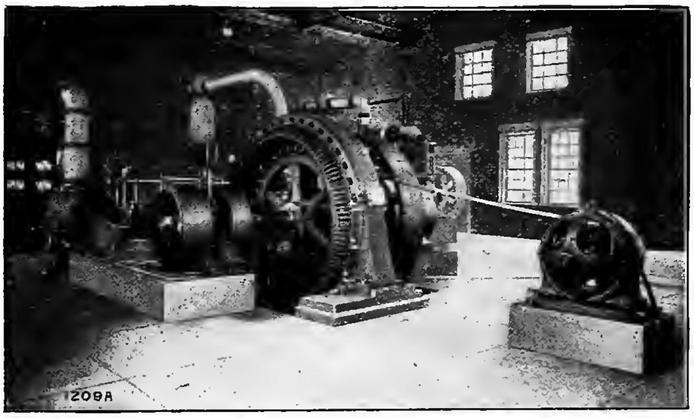
It is well to remember that alternators are designed for the voltage indicated on the name plate. They must not be expected to give voltages considerably above normal with satisfactory performance of either exciter or alternator. This point is here mentioned because frequent attempts to raise the voltage an excessive amount have resulted in poor operation through no fault of either exciter or alternator. Furthermore, the rated current output should not be continuously exceeded.

Every now and then the air-gap between stator and rotor should be checked and the machine realigned, if necessary. This applies particularly to engine-type generators. Bolts and nuts should be kept tight, and receive as much attention in electrical machinery as in steam engines.

INDUSTRIAL

NATIONAL ALTERNATORS.

Recently the National Brake & Electric Company, of Milwaukee, installed in the plant of the Merchants' Heat, Light & Power Co., of Canton, Ohio, two 2-phase 2,300-volt alternators for direct connection to Russel cross-compound non-condensing engines. These alternators are of symmetrical lines with special operating characteristics. The frames are of cast iron with sole-plate extensions for supporting them on the engine foundation. Soft sheet-steel laminations are dove-tailed within the frame so as to form slots for receiving the windings. These laminations are carefully japanned to reduce core losses to a low value, and also insulate them from each other and are very rigidly supported between end plates at such intervals as are ample to insure good ventilation. The laminae are supported by distance plates which provide air passages. The armature windings are composed of strap-wound coils insulated with sheet material of high mechanical strength and dielectric properties. The completed coils are wrapped with linen tape and repeatedly dipped in a vat of special insulating compound. Exceptional care and attention to this part of the machine has resulted in close regulation and large over-load capacity.



The field spiders are of cast iron and are liberally dimensioned to withstand torsional and centrifugal strains. The fields of these generators are wound with copper ribbon in edge-wise fashion, thus exposing every turn of the coil to the air and giving a compact, rigid and practically indestructible coil. A special fibre paper insulates the turns of the coil from each other in a thoroughly effective manner. A special feature of these machines which contributes very largely to their low operating temperatures is the use of widely separated pole pieces, which construction requires a spider of large diameter and prevents crowding of the coils; thus the coils have a large radiating surface. The method of bolting the pole pieces to the rim of the spider gives unusual accessibility to any portion of the armature or field winding. The bearings of these machines are of generous size, which gives a large wearing and radiating surface; they are babbitt-lined and are made with a sufficient number of grooves and oil rings to give uniform lubrication throughout the entire length of the bearing. The collector rings are built up on a separate skeleton-type spider which gives them splendid ventilation. The rings are cast iron and fitted with carbon brushes so that wear and attention are reduced to a minimum. The generators are excited with a current from 110-volt exciters which are belted to the shafts of the engines.

A NEW HYDRO-ELECTRIC PLANT IN CALIFORNIA, OF EXCEPTIONAL MAGNITUDE.

The Stanislaus Electric Power Company, through The Union Construction Company, has just closed a contract for an electric power transmission scheme of extreme importance to California industries. The site of the proposed plant is at Vallecito, on the Stanislaus River, near Angels' Camp., Cal., and the scheme contemplates the utilization of the waters of the Stanislaus River. Electric power will be transmitted to San Francisco, as well as to the Southern Mines and the upper San Joaquin Valley. From a hydraulic standpoint the project is of particular interest as it involves the largest power units that have probably ever been used for impulse wheels. The operating head is 1,400 feet, equivalent to a pressure of 608 pounds per square inch. The contract calls for three 6,700 kilowatt, General Electric generators, each of which will be driven at 400 revolutions per minute by a Pelton water-wheel unit of 12,000 horsepower capacity, thus giving the plant a capacity of 36,000 horsepower. Probably the only plant in the West, approaching this in the size of impulse of water-wheel employed, is that of the Puget Sound Power Co., at Electron, Wash., where are installed four Pelton wheel units, each driving a 3,250-kilowatt generator, with a combined maximum capacity for the station of 30,000 horsepower.

The units for the Stanislaus plant will be of the "double overhung" construction, characteristic of Pelton design for high-power practice. Each unit will consist of two Pelton wheels, each overhanging the opposite end of a heavy shaft which carries the rotor of the generator midway between. The wheels proper each consist of a cast-steel annealed disc-center to which are attached the Pelton buckets, also of cast steel. The buckets will be secured to the center by means of turned steel bolts hydraulically pressed into reamed holes —a novel idea in water-wheel construction. The shaft will be of fluid-compressed, hollow-forged nickel stell, and will be 28 feet in length, 20 inches in diameter at the center where the rotor is located, and 16½ inches at the water-wheel journals. The wheels and rotor will be designed for a press fit on the shaft at 100 tons pressure. The journals, one on each side of the generator, will be larger than any heretofore designed for this class of work, being 16½ inches in diameter and 60 inches lond. They are of the ring-oiling, ball and socket type, water jacketed and provided with an oil-pressure and gravity-feed lubricating system. Also there will be furnished electric thermostats and indicators to give warning of any excessive rise in temperature. The nozzles will be of the needle-deflecting type, admitting of close regulation and water economy, and are to be of cast steel, as are also the gate valves. These latter will be of the single-disc Pelton type, with phosphor-bronze seats ground in place. They will be provided with roller bearings to relieve the thrust on the stems, and will be actuated by gearing by means of small Petlon motors.

At the switchboard will be located the main pilot control, by means of which the operation of gates, nozzles and needles may be under the immediate control of the station attendant, small pelton motors and direct- acting plungers being employed for this purpose. All pressure parts on these units are to be subject to a cold-water test of 1,200 pounds per square inch in the shops before shipment. The equipment will represent the highest development in hydro-electric transmission, and the installation is looked forward to with the greatest interest by engineers generally. The construction is under the direct supervision of the engineer-

ing firm of Sanderson & Porter, New York. The complete hydraulic equipment will be furnished by the Pelton Water Wheel co., of San San Francisco, and the electrical apparatus by the General Electric Co.

Indications are that the year 1907 will eclipse its predecessor in the development of hydro-electric power transmission. The Pelton Water Wheel Company reports unusual activity in this direction, and will carry over unfilled orders aggregating the largest in the history of its business. The marked tendency is towards high speed, large-power units. For example, the California Gas & Electric Co. is installing a Pelton wheel of 10,500 horsepower maximum capacity. The Telluride Power Co., of Colorado, is adding to its equipment one 5,000-horsepower Pelton wheel operating under a head of 900 feet, and one 4,000-horsepower Pelton wheel operating under a head of 1,800 feet. This company has installed a continuous lapweld, high-pressure pipe made by the Ferrum Co., of Germany, which the Pelton company has introduced in America with much success in the past two years. The Siskiyou Electric Power Co. has ordered two Pelton water-wheel units, each of 2,000-horsepower capacity, these being in addition to their present water-wheel equipment.

PROGRESSIVE ACTION OF A PACIFIC COAST COMPANY.

The Telephone and Electric Company, of San Francisco. was recently incorporated to take over and carry on the old and well established business of the Brown-Spear-Sloane Company. For many years this latter firm has been acting as Pacific Coast representatives for many of the best known manufacturers of electrical supplies in America; and through its San Francisco, Los Angeles, Portland and Seattle branches has become well known to electrical jobbers in the West.

The new company differs from the old practically in name only, as the personnel remains very much the same. With an increased capital the company will carry on its business on a much larger scale, and has therefore incorporated under a name which specifically points out the class of merchandise dealt in.

The officers of the new company are: Frank L. Brown, president; Lewis E. Spear, vice-president; Victor Enginger, treasurer; and Garnett Young, general manager. Messrs. Brown, Spear and Enginger are well known through their connection with the old company, the Pacific Steel and Wire Company, and the California Wire Cloth Company. Mr. Young was in charge of the Los Angeles branch of the Brown-Spear-Sloane Company for the past three and a half years.

The sales department of the San Francisco branch will be in charge of Mr. Ralph L. Phelps. Mr. H. H. Manny will manage the Seattle and Portland branches, and Mr. A. B. Vandercook the Los Angeles branch.

The department of telephone appliances is in a position to furnish everything in telephone apparatus necessary to fully equip independent telephone exchanges. The electric supply department includes a general line of materials and appliances for electric wiring and lighting as well as heavy construction equipment of the nature required by power plants and transmission lines, while the railway department furnishes overhead and track material for steam and electric roads.

As before pointed out, this company does not manufacture electrical supplies, but acts as representatives for large and well-known manufacturers. The local warehouses, maintained in connection with each branch, are kept heavily stocked with an extensive line of electric appliances, and jobbers sending in orders can expect prompt deliveries.

The general offices of the Telephone and Electric Equipment Company are in the Union Trust Company's building, San Francisco.

News Notes

ELECTRIC RAILWAYS.

San Diego, Cal.—H. E. Huntington has bought by wire 120 acres in Roseville from F. D. Murtha. The positive assertion is made that a $700,000 water system will be established in the San Luis Rey Valley, which Huntington bought a year ago, and that the line to this city will be operated by electricity generated from dams to be constructed. Twenty thousand horsepower will be generated.

Chesaw, Wash.—Commissioners granted a franchise to the Okanogan Electric Ry. to construct its line from Nighthawk to the Columbia Valley. A. M. Dewey, president.

Chewelah, Wash.—The United Copper Co. has completed survey for its electric road from the mine to the Spokane Falls & Northern Ry. yards.

Butte, Mont.—James Breen and associates of Spokane, propose to construct an electric line from here to Anaconda by way of Gregson.

North Yakima, Wash—Work will be commenced at once by Engineer E. M. Kenley locating an electric suburban railway connecting a number of valleys with this city.

Portland, Ore.—C. E. Loss of the United Railways Co. states that work will be commenced within 30 days on the Front-street line.

Seattle, Wash.—Council granted franchise to S. E. Co. for construction of street railways on Summit avenue et al; 31st avenue et al; 19th avenue, Ewing street and Wallingford avenue et al.

Spokane, Wash.—The Inland Empire Railway Co. awarded contract for fencing its line from Palouse to Moscow, a distance of 32 miles, to the Excelsior Fence Works of this city.

Reno, Nev.—The directors of the Nevada Interurban Electric Railroad Company, recently formed in this city for the purpose of building a railroad from Reno to Moana Springs, and eventually to Lake Tahoe, have ordered a large quantity of ties and the steel for the new line. Work on the road will commence next week and will be rapidly rushed to completion.

Alameda, Cal.—A condemnation suit, filed January 2nd by F. M. Greenwood, a San Francisco capitalist, who obtained a franchise to operate an electric railway in Alameda last March, marks the first act taken toward the construction of the line. Linwood Palmer and Timothy L. Barker are named as defendants. The land sought to be condemned by Greenwood is a strip 60 feet wide, running along the extension of Clement Avenue from the extension of Pearl Street to the extension of Versailles Avenue. The Cohen property is its eastern boundary. It is a little more than 404 feet long. The Greenwood line, as applied for, is to connect with a ferry boat on the western shore of Alameda, about 2,000 feet south of the Alameda mole of the Southern Pacific. Quick ferry service between Alameda and San Francisco is part of the program. From this point the line runs across the Alameda marsh, crossing Webster Street near the old powerhouse of the Oakland Traction Consolidated. It strikes Clement Avenue at its western end and runs along that thoroughfare to its end. Haywards is named in the complaint as the eastern terminal of the road. Branch roads in Alameda are also contemplated. Although the franchise was granted nearly ten months ago, no step toward actual construction of the road has yet been taken. The Board of Trustees of Alameda has granted extensions of time to the company, which pleaded that it had been impossible to begin. At the time of the granting of the franchise it was freely hinted that the line projected was part of a transcontinental line that was attempting to get into San Francisco, and Greenwood admitted that his company was an adjunct to a greater plan.

TELEPHONES AND TELEGRAPH.

Bellingham, Wash.—The directors of the Farmers' Tel. Co. decided to at once extend the lines of the system. Work on the South Pass line to Kendall and Maple Falls is now under way.

Centralia, Wash.—Lumbermen are planning to build a private line to connect the different saw mills.

Diamond, Wash.—The Diamond Tel. Co. has been incorporated by F. W. Estel, W. M. Lee and Henry Rock, capital $2,000.

Spokane, Wash.—The Interstate Tel. Co. announced that its toll line is now completed into the city.

Oakland, Cal.—The Sunset Telephone & Telegraph Company is preparing to spend an immense amount of money in improvements in Oakland. The business has grown to such an extent in the past few months that it is almost impossible to handle it from the present main office—at least, it will be impossible to do so when the improvements at present under way are completed. To handle the growing business a class-A reinforced concrete building is to be erected at once at the corner of Telegraph Avenue and 45th Street. This building will cost $40,000, and will be two stories in height. It will be one of the finest office buildings owend by the company in the State. C. W. Dickey is the architect.

Pacific Grove, Cal.—The Monterey City Board of Trustees has granted the Monterey, Fresno and Eastern Railroad the right of way for telegraph and telephone lines and a double-track electric roalroad over certain streets, for fifty years.

Oakland, Cal.—The division manager, Peter J. Lynch, of the Pacific Telephone and Telegraph Company, states that his company will establish a branch office in the Fruitvale and Elmhurst district. The building will be erected on their lot on San Leandro Road, near Aakland Avenue, of reinforced concrete and brick, and will be equipped with a multiple switchboard, which will control the telephones.

Elsinore, Cal.—An ordinance has been passed, granting to the Southwestern Home Telephone Company the right to construct a telephone, telegraph, electric light, heat and power line in Elsinore.

OIL.

Hanford, Cal.—E. Fitzpatrick, who has been over in San Benito County drilling a well for the New England-California Oil Company, is spending a few days in Hanford. Mr. Fitzpatrick says that several wells were put down over there, but the drilling was stopped before the wells had gone deep enough to show whether there was oil there or not. The company is to do deeper prospecting.

Vallejo, Cal.—James Clyne, a well-known Benicia resident, has transferred to a Los Angeles oil company, 26 acres of land midway between Vallejo and Benicia on the Carquinez Straits. The new corporation plans to build an oil refinery for crude oil which will be brought from the southern fields. A spur track three miles long is to be built by the Southern Pacific Company from Benicia, to furnish shipping facilities for the plant. The company will build a large number of steel tanks on the hills back of the works. The new concern has already ordered 500 tons of structural steel for the commencement of building operations, and no time will be lost in getting the new project under way.

Eureka, Cal.—The North Mountain Power Co. has just received 10,000 barrels of oil from the Associated Oil Co. Owing to the scarcity of coal many of the manufacturers in this section are changing to oil.

POWER AND LIGHT PLANTS.

Kalispel, Mont.—The interest of the Tinkels and Conrads in the Big Fork Water Power plant have been taken over by the Flathead Valley Power Co., which recently filed articles of incorporation. The new company is capitalized for $50,000. Fifty thousand dollars will be expended in improvements at the Big Fork plant; 2,000 horsepower will be developed. C. T. Moffett, manager.

Leavenworth, Wash.—The G. N. has a surveying party at work locating a large power plant at Big Lake. It is expected to develop more than 100,000 horsepower.

Seattle, Wash.—Superintendent Youngs has received notice that a 4,000-pound carload of electric light wire was on its way here from Perth Amboy, N. J.

Seattle, Wash.—Council has decided that both First and Second avenues are to be l·ghted with cluster lights.

Spokane, Wash.—It is reported that $2,000,000 will be expended by the promoters of the Ox Bow power project before their plant is complete.

The Kern River Power Plant No. 1 of the Edison Electric Co., is to have the gate valves on the 28-inch water gates controlling the hydro-electric equipment there, operated by Allis-Chalmers vertical shaft motors and gearing.

Redding, Cal.—The Northern California Power Company, which already has three power plants in this county, has commenced work on a fourth, which will have a greater capacity than the other three combined. The new plant will be erected on Battle Creek, below Volta, and will be of a capacity to develop 12,000 horsepower, or 2,500 horsepower more than the other three combined. Men have been set at work on the construction.

Carson, Nev.—James T. Shaw, a prominent mine owner of the district of Masonic, Cal., is in the city arranging for the building of a large electric plant in the new mining camp of Mono County. The machinery has been ordered from San Francisco, and the company, of which Mr. Shaw is president, intends to begin the construction of the plant in a few weeks. The plant will be used for lighting and to work a number of electric hoists being erected in the district.

Chico, Cal.—W. J. Bowen, who has been serving the Northern Electric Company in the capacity of purchasing agent, has been advanced to a place in the right-of-way and land department of that company. He will be associated with G. E. Springer in the work attached to securing rights of way. The successor to Mr. Bowen is M. C. Jones, of San Francisco.

Kennet, Cal.—Considerable interest is being taken in the operations of the Northern California Power Company in the construction of its 50-ton experimental electric smelting plant for iron ores, to be located six miles east of Kennet, near the confluence of the McCloud and Pit rivers. Operations are under the supervision of W. S. Morgan, of San Francisco, and a force of about 25 men is at present employed.

Redding, Cal.—The Shasta Power Company has completed setting poles throughout Redding, covering the section bounded by North, East, West and South streets. The pole lines run through the alleys, instead of on the streets. The poles of the main line, from Redding to the power plant,

It is reported that the Eureka Lighting Co. is about to close down its Station "A."

Eureka, Cal.—The North Mountain Power Co., which secured the contract for the city lighting for the coming year, were somewhat delayed in putting in service their "Magnatite" lmps, due to certain machinery not arriving on time. These lamps are now in good working condition.

POWER PLANTS.

Porterville, Cal.—A. Genslein, general manager of the Porterville Gas and Electric Company, has been in Los Angeles and there met with the board of directors for the purpose of getting a report of their engineer, J. R. Thompson, who was here last week. The engineer was ordered to make drawings, plans and specifications for a complete gas plant for the city of Porterville at once.

Pasadena, Cal.—Bids have been opened for the issue of $200,000 municipal bonds, $125,000 of which are for electric lights and $75,000 for fire department extension, and the award was made to E. E. Webster, formerly connected with one of the local banks, who bid par value together with accrued interest to date of delivery. It is thought Mr. Webster represents a syndicate of Los Angeles capitalists.

Fort Bayard, N. M.—Sealed proposals in triplicate, for furnishing and installing electric light fixtures in the Post Exchange at this post, will be received here until January 23rd, and then opened. The United States reserves the right to accept or reject any or all proposals or any part thereof. Envelopes containing proposals should be endorsed: "Proposals for Electric Light Fixtures in Post Exchange," and addressed to Captain S. P. Vestal, Quartermaster.

Los Angeles, Cal.—An application has been made to the Board of Supervisors, by the Pacific Light and Power Company for a franchise to set poles, string wires and furnish electric light and power over same, on every road in the county, except where it has not now such wires, and also excepting in incorporated towns. The District Attorney was directed to draw up a notice of the sale.

Bisbee, Ariz.—E. F. Gressler, manager of the International Gas and Light Company, is en route to Los Angeles to make arrangements for the delivery of material for installation of the electric lighting plant, for which his company was granted a franchise.

Los Angeles, Cal.—An ordinance has been adopted ordering that necessary appliances be installed and electric curren be furnished for one year for lighting Carr Street between the center line of Main and the center line of Hill Streets, sealed proposals for which will be invited.

FINANCIAL.

San Francisco, Cal.—The interests represented by the Fleishhackers, the London, Paris and American Bank and the San Francisco Coke and Gas Company, are reported to be preparing to combine the power and paper interests of the Fleishhackers at Floriston, on the Truckee River, and the local plant of the San Francisco Coke and Gas Company. The companies will be financed by the London, Paris and American Bank, in which the Fleishhackers and Leopold Michels, president of the gas company, will soon become heavy stockholders. Sigmund Greenebaum will continue as president of the bank.

New York, N. Y.—In an interview on January 8th, Ernest Thalman says he expects a gradual appreciation in United Railroads securities. This is his comment after giving out a statement of the earnings for December and for the year. He talks optimistically on both San Francisco and the company. He says that, "Notwithstanding the delays and losses occasioned by the fire and strike in San Francisco, the gross receipts of the United Railroads for 1906 have decreased only $1,116,000 from the earnings of 1905, which were $5,941,000. The gross passenger receipts for December were $556,000. The officers and directors of the United Railroads are confident that the rebuilding of San Francisco will go forward with continued vigor. They report the labor situation steadily improving, and that the company now has no difficulty in obtaining all the labor necessary for the reconstruction of its old cable lines, and the entire work of reconstruction will be finished by Spring. It is confidently believed that the earnings for 1907 will exceed those of 1905."

TRANSPORTATION.

Vallejo, Cal.—Contractor Frank Gore of this city has commenced grading for the Vallejo, Benicia and Vaca Valley electric road, about two miles from this city, on the Benicia road. Over 1000,000 ties have arrived for the Vallejo and Napa Interurban electric road, and these will be used in the extension of the road from Napa to Calistoga.

San Francisco, Cal.—The first shipment of the United Railroads' new special San Francisco cars have come out of the factory at St. Louis and have been started westward. Agents are to placed along the railroad to see that the consignment is nowhere unnecessarily delayed. The cars are expected January 21.

Fresno, Cal.—One of the surveyors of the New Yosemite electric road is now in Fresno. He brings word that the survey is progressing rapidly, notwithstanding the fact that the weather is disagreeable and the snow is a foot or so thick on some parts of the mountains. The line has now been located to within five miles of Crane Valley. Once this valley is reached the important part of the work will have been accomplished, for there Chief Engineer Newman will be in a position to make his estimate which will determine whether the road will or will not be built. The 18 miles that have been surveyed thus far have come quite within the estimate, so that it would seem certain that the cost of construction on the remaining five miles could not possibly be so expensive as to offset the advantage gained on the 18 already covered.

Woodland, Cal.—Several property owners of this city have been approached by representatives of the Vallejo and Northern Electric Railway Company with reference to options on their property. The property owners refuse to talk about the matter, but it has been ascertained that the negotiations are in progress.

Salinas, Cal.—The electric road that has been promised between Monterey and Salinas seems in a fair way to be realized. Last week surveyors started out from Monterey to find the shortest and most feasible route from that city to Salinas, and it now looks as though construction work will begin in January. It is believed that this piece of roadway will be part of the line between Monterey and Fresno.

San Diego, Cal.—Papers are now being prepared for filing with the City Council, by W. G. Kirkhoff and P. W. Keller, asking for the granting of franchises to the extent of 33 miles, for the benefit of H. E. Huntington. These franchises include those held for some time by H. T. Richards, the well-known surveyor, who has been supposed to be in the service of the Southern Pacific. They include a line along the water front, across the mouth of False Bay and north via La Jolla and Delmar toward Oceanside and Los Angeles; and another up Mission Valley toward Escondido. The other portion of the franchise is for branches to Ocean Beach and Point Loma. A bond of $20,000 is offered to insure commencement of work inside of 90 days.

Reno, Nev.—It is stated in this city that the Southern Pacific Company is planning to reconstruct its line from Reno to Carlin, a distance of about 250 miles, and run electric trains between the two places, instead o fsteam trains. It is the intention of the company to install electric engines and to increase the speed schedule from Sparks to Carlin. Engineer Barclay, who has charge of Southern Pacific construction work in Nevada, was in town a few days ago for the purpose of estimating the cost of the electric project. It is reported in railroad circles that the electric engines and trains would be able to travel at a speed of nearly 150 miles per hour across the Nevada Desert. The railroad company will obtain its power from the Truckee River General Electric Company, which operates four power plants along the banks of the Truckee River between Reno and Floriston.

POWER AND LIGHT PLANTS.

Boise, Ida.—H. B. Perrine of Seattle states that his firm is figuring on installing machinery for the completion of the power plant at Shoshone Falls. A transforming house is to be built at Twin Falls.

Columbia, Wash.—Preparations are said to be under way for the construction of a gas plant here by H. J. Miller of this city, to cost $30,000.

Livingston, Mont.—The Livingston electric light plant, owned and managed by J. L. Bright, was sold to Henry F. Kroyer of New York. M. Hebgen, superintendent of the Butte Electrical Works, will supervise the work of extending the power from the Madison River Power Company's lines to connect with the plant here.

North Yakima, Wash.—The reclamation service sent a force of men to the Tieton River to arrange for the construction of a large electrical power plant, to be used in connection with the building of the Tieton Canal.

Spokane, Wash.—Henry M. Richards of the W. W. P. Co. states that plans are being made for increasing the electric plant of the company to at least 70,000 horsepower. The capital stock of the company is to be increased to $10,000,000.

Boise, Ida.—Guy C. Barnum of Shoshone has sold his interest in Thousand Springs Land & Transportation Co. to A. M. Harris. The company is building a power plant in Lincoln County that will develop 12,000 horsepower.

Cheyenne, Wyo.—The Northern Colorado Power Co., which purchased the plant of the Cheyenne Light, Fuel & Power Co., is contemplating the erection of a new electric plant, estimated cost, $1,000,000.

CLASSIFIED LIST OF ADVERTISERS

Air Compressors
Henshaw, Bulkley & Co.
Hunt, Mirk & Co.
Platt Iron Works
Rix Comp Air & Mach. Co.

Alternators
Allis-Chalmers Co.
California Electrical Works
National Electrical Co.

Aluminum Electrical Conductors
Pierson Roeding & Co.

Annunciators
Aylsworth Co., H. G.
California Electrical Works.
Century-Klein Electric Co.
Patrick, Carter & Wilkins Co.

Asbestos Products
Johns-Manville Co., H. W.

Automatic Sprinklers
Pacific Fire Extinguisher Co.

Batteries, Primary
California Electrical Works
Electric Appliance Co.
Gould Storage Battery Co.
Standard Electrical Works
Western Electric Co.

Batteries, Storage
Century-Klein Electric Co.
Gould Storage Battery Co.
Electric Storage Battery Co.

Blue Printing
Dietzgen Co., Eugene

Boilers
Henshaw, Bulkley & Co.
Hunt, Mirk & Co.
Keystone Boiler Works
Moore, C. C. & Co., Inc.
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Standard Electric Works
Tracy Engineering Co.

Boiler Compounds
Dearborn Drug & Chem. Wks.
Johns-Manville Co., H. W.

Buffers
Northern Electrical Mfg. Co.

Chemists and Chemical

Building Material
Johns-Manville Co., H. W.

Building Paper
Johns-Manville Co., H. W.

Circuit Breakers
Cole Co., John R.
Electric Appliance Co.
Fork Wayne Electric Works
Kilbourne & Clark Co.
Century-Klein Electric Co.

Compressed Air
Electric Manufacturing Co.
Pacific Elec. Mfg. Co.

Condensers
O. C. Goeriz & Co.
Rix Comp Air & Mach. Co.
C. H. Wheeler Mfg. Co.

Conduits
American Circular Loom Co.
American Conduit & Mfg. Co.
Aylesworth, H. G.
Cole Co., John R.
Electric Appliance Co.
Century-Klein Electric Co.

Conduit Fixtures
American Conduit & Mfg. Co.
Aylesworth, H. G.
Electric Appliance Co.
Century-Klein Electric Co.

Cooling Towers
O. C. Goeriz & Co.
C. H. Wheeler Mfg. Co.

Cross Arms
Carter & Co., George E.
Electric Appliance Co.
Century-Klein Electric Co.

Draftsmen
Eureka Drafting Room

Drawing Materials
Dietzgen Co., Eugene
Leitz Co., A., The

Dynamos and Motors
Allis-Chalmers Co.
Brooks-Follis Elec. Corp.
Bay Shore Elec. Con. Co.
California Electrical Works
Century-Klein Electric Co.
Electric Manufacturing Co.
Fort Wayne Electric Works
General Electric Co.
Kilbourne & Clark Co.
Northern Elec. Mfg. Co.
Standard Electrical Works
Westinghouse Elec. & Mfg. Co
Wagner Elec. Mfg. Co.

Elevators
Van Emon Engineering Co.

Electric Blowers

Electric Car Heaters
Johns-Manville Co., H. W.
Northern Electrical Mfg. Co.

Electric Grinders
California Electrical Works
Northern Electrical Mfg. Co.

Electric Heating Devices
Johns-Manville Co., H. W.

Electrical Instruments
Cole Co., John R.
Cutter Co., The
Electric Appliance Co.
Fort Wayne Electric Works
General Electric Co.
Kilbourne & Clark Co.
Stanley-G. I. Elec. Mfg. Co.
Westinghouse Elec. & Mfg. Co.
Weston Elec. Instrument Co.
Century-Klein Electric Co.

Electrical Machinery
California Electrical Works
Northern Electrical Mfg. Co.
Standard Electrical Works
Century-Klein Electric Co.

Electric Polishers
Northern Electric Mfg. Co.

Electric Railway Appliances
Pierson, Roeding & Co.
Johns-Manville Co., H. W.

Electrical Supplies
Aylesworth Co., H. G.
Bay Shore Elec. Const. Co.
California Electrical Works
Standard Electrical Works
Century-Klein Electric Co.

Electric Ventilating Fans
Century-Klein Electric Co.
California Electrical Works
Northern Electrical Mfg. Co.

Engines, Boilers, Heaters, etc.
Allis-Chalmers Co.
Henshaw, Bulkley & Co.

Electric Watchman's Clocks
Pacific Fire Extinguisher Co.

Engineers, Chemical
Smith, Emery & Co.
Moore & Co., Chas. C., Inc.
Ohmen Engine Works
Standard Elec. Works
Tracy Engineering Co.
Westinghouse Machine Co.
Hunt, Mirk & Co.

Engines, Gas and Gasoline
Allis-Chalmers Co.
Henshaw, Bulkley & Co.
Moore & Co., Chas. C., Inc.
Westinghouse Machine Co.
Hunt, Mirk & Co.

Engineers and Contractors
Brooks-Follis Elec. Corporat'n
Bay Shore Elec. Const. Co.
Byllesby & Co., H. M.
California Electrical Works
Cannon, Edward F.
Century-Klein Co.
Cole Co., John R.
Copeland, Clem A.
Doble Co., Abner
Cory, C. L.
General Electric Co.
Hunt, Dillman, Meredith & Allen
Hall, Leon M.
Hunt, Mirk & Co.
Jackson, D. C. & W. B
Kilbourne & Clark Co.
Smith, Emery & Co.

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POWER AND GAS
WITH WHICH IS INCORPORATED
The Engineers', Architects' and Builders' News

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The Engineers' Architects' and Builders' News

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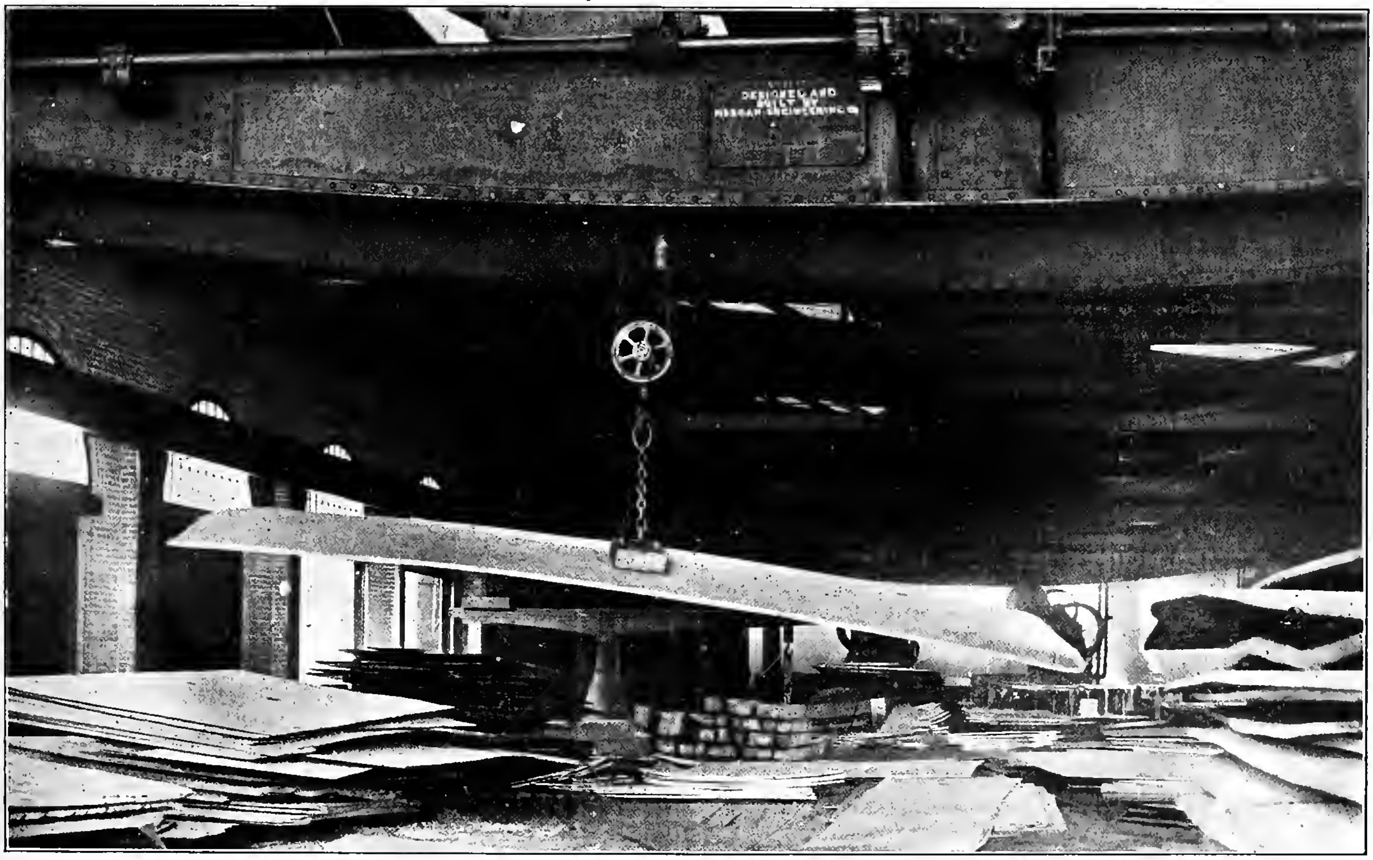
Lifting Magnets in Iron and Steel Works.

The modern electrically operated crane is one of the most practical and efficient of all the labor saving devices now utilized in the machine shop, foundry, and iron and steel plants. The electric current, besides being available for operating the crane, can also be utilized to advantage for energizing electro-magnets for lifting iron and steel castings, rolled angle iron, plates, girders, and even finished machinery.

It is very difficult in many cases to properly hold the various castings, plates and rails to the hooks of the traveling crane by ropes or chains. Lifting electro-magnets have many advantages in this respect, and permit a much greater speed of operation. The accompanying illustrations show the construction and emthod of operation of lifting electro-magnets of German, Belgin, and American design. Lifting magnets have been utilized to advantage in German iron and steel works. A method of lifting groups of angle irons in a German shop is shown in Fig. 3. It will be noticed that hooks are provided for use, to ensure against dropping the load in case the current is for any reason shut off.

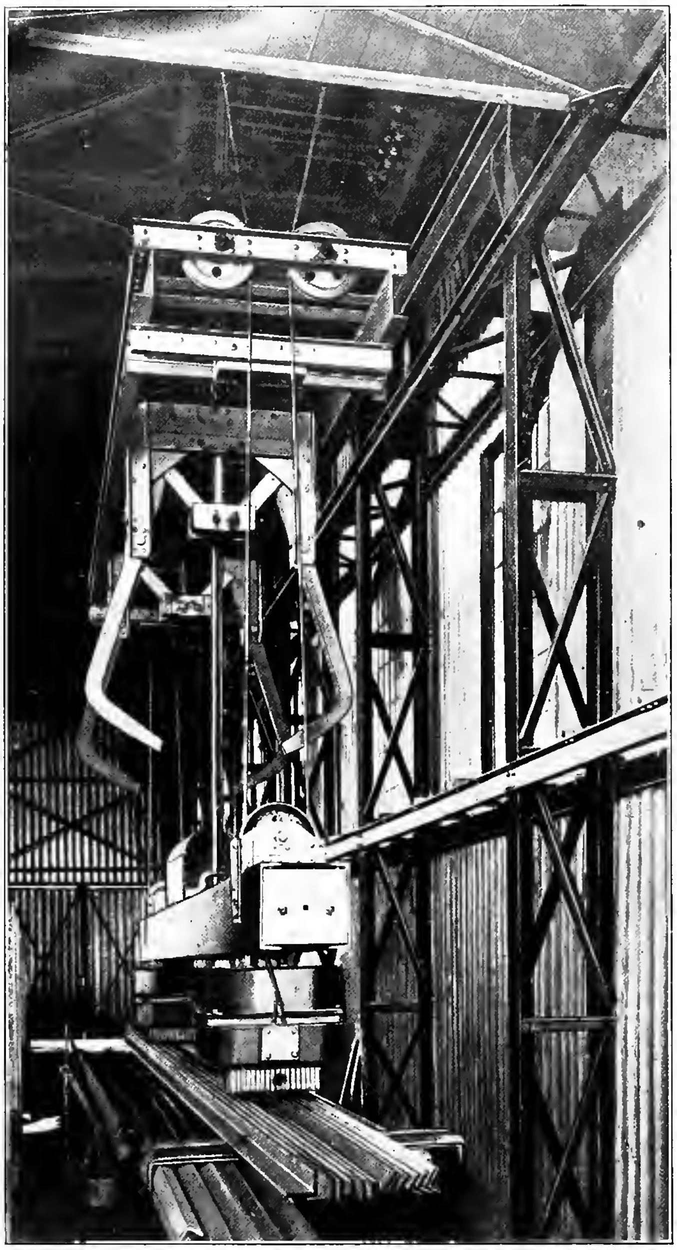


LIFTING MAGNET IN AN AMERICAN STEEL WORKS.

These magnets are capable of supporting a maximum load of 4,500 pounds, and the crane has a hoisting speed of 50 ft. per minute, the trolley traveling at the rate of 150 ft. per minute, and the crane operating at a speed of 328 ft. per minute. The German crane and electro-magnet equipment shown in Fig. 3 utilize a three-phase alternating current of 400 volts pressure for operating the motors, while the lifting magnets are energized by direct current at 230 volts supplied by a rotary converter, the motor end receiving the three-phase current at 400 volts, and the direct current end delivering continuous current at 230 volts to two lifting electro-magnets mounted on the same hoisting frame.

The construction of an electro-magnet for lifting heavy pieces of iron and steel, and the design of the same, would seem to present no great difficulties, but up to the present time, but few manufacturers have been successful in placing apparatus of this type on the market. Lifting magnets have been designed by engineers in this country especially for handling steel plates. Some of these are now in operation

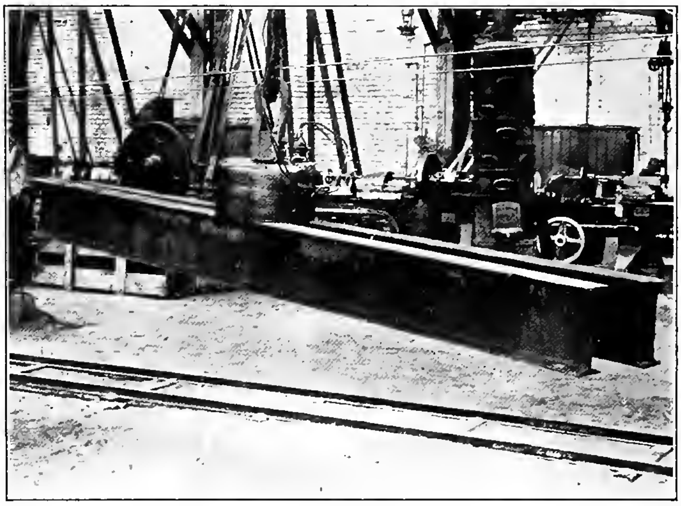
at the works of the Otis Steel Company, as well as in other iron and steel plants, and have given excellent satisfaction. Those in the Otis Steel Company's works were designed and constructed by the Electric Controller & Supply Company of Cleveland, Ohio.



GERMAN ELECTRO-MAGNET SUPPORTING A LOAD OF ANGLE IRONS.

At Liege, Belgium, at the electrical works of the Compagnie Internationale d'Electricite, lifting magnets of the type shown in Fig. 2 are constructed. The designing engineers claim a high efficiency and many superior merits for this type. It is maintained that the electro-magnet when well designed and constructed, and successfully operated, permits of a great saving in manual labor and time. Ropes and chains have always been employed heretofore for attaching the load to the hook of the crane, and this required the services of at least two or three men, on account of the heavy and awkward pieces of metal that have to be carried from one part of the shop to another.

By means of the electro-magnet, all of the operations are carried out by the attendant on the crane, entirely doing away with the ropes and the men required to fix the tackle. The crane driver simply lowers the magnet on to the piece of metal to be lifted, and excites it by closing a switch. The load is raised, swung over the desired location and lowered. The exciting circuit of the magnet is then opened, and the hook and magnet raised by the crane and moved back for the next load.



ELECTRO MAGNET IN A BELGIAN SHOP.

It is claimed by those operating this type of apparatus that a load may be picked up in an exceedingly short time, only two or three seconds being required for sufficiently magnetizing the lifting magnet. The enormous saving in time thus made allows a greater output for each crane, so that fewer cranes are required to do the same amount of work. While it is true that there is a greater consumption of power the amount of current used is not large enough to be considered an important factor. An electric lifting magnet which is capable of sustaining 2½ tons, according to the data given by the Belgian engineers, requires about 750 watts.

There are two types of lifting magnets constructed at Liege, the single and the double type, the latter being simply composed of two of the single type magnets, one fixed at each end of a beam, suspended at the middle from the crane hook. The International lifting magnet consists of two parts, the outside bell shaped cover and the magnet proper. The cover is utilized to protect the inside mechanism from any shocks which might occur, and from exposure to the atmosphere when the crane is operated in the open air. The current is supplied by two conductors placed along the length of the crane, the connection being made by contact pieces attached to the crab. Both pig and scrap iron can be handled, either hot or cold, but the design of the magnets varies somewhat with the character of the work to be lifted. The lifting magnet will, no doubt, be more extensively used in the future as the rapid introduction of electrically driven machine tools brings with it more available sources of electric power.

A GENEROUS OFFER.

In connection with the announcement of the Co-operative Electrical Development Association, offering $2,600 in prizes for material for a Solicitors' Handbook, the Holophane Glass Company state that the services of their engineering department are at the disposal of any persons wishing information in regard to the subject of illuminating engineering.

This offer will be of great value to any who intend to enter this competition, as information from the Holophane Glass Company will be of the greatest value on account of their extended experience in the field of illumination.

HIGH-PRESSURE FIRE SYSTEMS.*

By F. L. Hand.

The question of having an adequate water supply for conflagration purposes was fully impressed on the city of Philadelphia by the action of the board of underwriters in the year 1900. The insurance companies at that time increased the rates twenty-five cents per one hundred dollars insured on all risks in the district where are located the large wholesale and retail stores and office buildings which one is apt to find in the congested business district of a city numbering one and one-half millions of inhabitants. The increasing of the rates of insurance twenty-five cents per hundred dollars naturally raised a stormy protest from the business men, and the matter was immediately taken in hand by the Trade League, a committee of which waited on the underwriters to learn the reason for the increased rates. The underwriters replied inadequate water supply and fire-fighting inefficiency.

Both bodies recognizing this, waited on the Mayor with a proposition that if a more efficient fire service could be had the underwriters would bring their insurance back to the old rating. The Mayor of the city, feeling the hardship of such an increased rate made upon the business community, immediately instructed me, as Chief of the Bureau of Water, to devise a method of water supply for conflagration purposes that would be effective in not only reducing insurance rates but increasing the efficiency of the fire department, so as to enable it to cope with large conflagrations for all time to come, that is to say, be adequate enough to keep pace with increased size and area of new structures.

The Problems Involved.

In considering this proposition the main problems to be solved were: First, an independent pipe service entirely free from any connection with the existing distribution system. Second, the use of raw water for conflagration purposes. Third, a power plant independent of any other pumping plant in the water department, and such a power plant being called on intermittently for service, required for economical operation that the usual stand by losses be eliminated. Hence the motive power—steam, gas or electricity, had to be considered along economical and assured lines. Fourth, the standard of efficiency in fire department equipment and management had to be correspondingly increased to meet the new conditions of a 300-pound working pressure, which was to be maintained without diminution as long as required. Fifth, the combined high-pressure system should be equivalent to twenty of the best steam fire engines in the Philadelphia fire department, the same to be rated with a pumping capacity equal to five hundred gallons per minute.

Comparison of Different Systems.

The whole subject of fire protection by high-pressure pumping stations is so new, and the conditions so different to any other service, that in making comparisons between various systems the ordinary arguments for and against have little application, and must be regarded from an entirely new viewpoint. For example: In the ordinary power plant, whether used for pumping, lighting, car service or manufacturing, low cost of operation during use is the most important consideration, since this is the normal condition of the plant. In fire service this really is of small account, since the normal (and ideal) condition of the plant is standing idle, but ready for use at any moment.

The reverse is equally true, the cost of maintenance while standing idle is of small account to the ordinary plant, but is the chief item in a fire service station.

*From a paper presented to the American Water Works Association, Boston, July, 1906.

Similarly, while certainty of starting and of operation is desirable in the ordinary plant, they are absolute necessities in fire service, and a pumping station which is liable to be ten minutes late in starting or to stop for half an hour while running, might as well, in fact, better, not be built at all, since dependence upon it would lead to the neglect of other precautions.

Wear due to operation is of great moment in the ordinary plant, while in the fire station it is of little importance, owing to the low total running hours, but non-liability to accident is a large factor with the fire service, since its infrequent operation gives none of that opportunity to detect gradual deterioration or misadjustment which constant running gives in the ordinary plant. Comparisons based on the first cost, too, require absolutely new treatment, owing to the entirely different conditions governing depreciation and replacement. Considering the subject in this way we may set the various requirements of a high-pressure pumping station in the following order of importance:

Certainty of starting promptly on call.
Certainty of operation when started.
Low first cost of maintenance when standing idle.
Low liability to depreciation or accident when standing.
Low first cost.
Low cost of operation when running.

Three systems are open to any place in considering high-pressure pumping plants: First, steam pumps and boilers. Second, electrical-driven pumps taking current from a central station. Third, gas engine-driven pumps.

The usual condition in which a steam plant is considered to be ready for instant service is either with fires laid in quick-steaming boilers or with fires banked and some pressure on in ordinary boilers; to be truly ready, the boilers must have steam up, fires burning freely, and engines or pumps hot and turning over slowly. This entails prohibitive expense. It may be argued that this may be done where a city has a steam pumping plant for its ordinary service, but this I shall discuss under the head of electric drive.

Steam machinery may be considered reliable in operation dependent on the usual limitations of stuffing boxes, piston rings and steam pipe lines with their joints, drip valves, etc. Steam machinery costs almost as much to maintain when standing idle as when operating regularly. It must be run constantly or the rings and internal parts will rust, and perhaps stick fast, and a few days' rust scraped off will equal many weeks' honest wear, besides the fact that all damage is done internally where it is difficult of access for examination.

A pump driven by electricity from a central station is a very tempting proposition, especially as local companies will often make very low offers for power for such a purpose. In the case of sewage disposal, or the like, where the power will be used wholly or chiefly during the hours of light station load, such an offer is a legitimate business proposition.

The idea that by closing a switch the power is instantly available is most enticing, but it must be remembered that electricity is not a generator of power, but only a means of transmission, exactly as a belt or rope is, and the limit of power which a central station can furnish on sudden call is the actual surplus boiler, engine and dynamo capacity in use at the moment of alarm.

In other words, to be fully fitted for an electric-driven station the electric company would have to install, in addition to its regular plant, boilers, engines and dynamos to 25 per cent. greater capacity than your pumping plant, and keep this apparatus under constant steam ready for use. No company will do this except for an enormous rental or maintenance charge, and, if they would, it would be simpler and cheaper for one to install a steam plant and save the cost of the electrical conversion of energy.

For reliability of operation of electric pumps I can only refer to the liability of interruption of service. The safety

devices required for the protection of the central station machinery are the danger devices which may cut off your supply at any minute or instant, and the fire which you are fighting may disable the overhead lines which supply your power. Even in Philadelphia, with its many stations, and all underground electric mains, in the two years of operation of the high-pressure pumping station the one failure of any part has been the interruption for half an hour of the ignition current from the Edison mains. As we equipped the station with three different methods of ignition this caused no trouble, but it is suggestive that the only failure of any part should be the outside electric current.

Every failure of lights, every stoppage of the trolley cars, means that this might happen to a fire plant, and if these happen on an apparatus which is a part of the regular and daily operation of the station, what would it be when you throw on them without warning from 200 to 1,000 horsepower? If there is any class of machinery subject to depreciation in an unseen and undetected way it is motors and dynamos. So thoroughly did we recognize this in the Philadelphia plant that in using electric ignition we installed no fewer than three independent methods and congratulate ourselves that the only one which has ever failed, failed outside the pumping station.

Reliability of Gas Power.

Compare with this the gas engine driven pumps as installed by us in Philadelphia. In over two years of actual service, including alarms of fire, several of the most exacting tests by the city officials and experts from the underwriters, and constant runs for training and practice of attendants, not once has any one single unit failed to get full pressure on the mains in less than one minute, actual timing.

The average time is 40 to 45 seconds, the record time 27 seconds from the time the alarm sounded, with a further record of nine engines started and pumping 10,000 gallons per minute in less than 7 minutes; the whole being done by the regular crew of one engineer and two oilers.

No unit has ever stopped during a run, and before the plant was accepted one unit was taken at random and run overload for twenty-four hours without a moment's stop and when shut down the oil cups were simply shut off and the engine reported ready for duty. The only thing which can affect the Philadelphia station would seem to be a failure of the gas supply. I am not prepared to answer for other localities, but in this city there is no recorded failure of gas supply in forty years.

The gas engine and pump cost nothing when not running, the instant you do not need them the closing of the gas valve cuts off fuel expense. No banked fires, no wasted coal or oil, no steam pipes to watch, only the wages of the men to pay, and the slight charges for waste, etc., to keep the plant clean. I canot offer a better argument than the Philadelphia plant. It has converted the underwriters from opponents of the gas engine proposition into its warmest advocates. And Philadelphia has the honor of being the first city in the world to establish an independent central power station for use as a fire fighting medium only.

The high pressure fire pumping station was put into service under the jurisdiction of the Department of Public Safety February 15, 1904, on which date the fire boats were discontinued as a source of water supply to the special pipe lines.

As the mechanical installation called for a guarantee of one year after completion by the contractors, steps were immediately taken to carefully try out all the mechanism under various loads and conditions, these tests applying to every engine and pump. These tests, coupled with actual service since erection, have more than demonstrated the value of a central power station as a fire fighting medium, and exceeded the expectations of every one connected with this new fire service.

The completion of the fire main pipe lines resulted in a reduction of insurance rates amounting to fifteen cents per hundred dollars, with an additional proviso on the part of the Philadelphia underwriters that a further reduction of ten cents per hundred dollars would be made upon the entire completion of the pumping station, making in all a total reduction of twenty-five cents per hundred dollars—whilst the pumping station and completed pipe lines were turned over to the Department of Public Safety for active service on February 15, 1904, it was not until April 19, 1904, that the full reduction in insurance rates (mentioned above) was allowed by the underwriters.

Test Required by the Underwriters.

At first the underwriters were adverse to the reliability of the gas engine as a means of motive power, and they demanded a test before their experts before accepting the plant. With this idea in view, they furnished me with a routine of operations which they desired the plant to fulfill, and are as follows:

(1) The station shall be started and run with the smallest number of men who ever would be on duty at a given time, and the reliefs shall be allowed to come on duty as they would in actual service.

(2) The minimum time of operating all the engines shall be twelve hours (not necessarily consecutive hours) for all engines, slight breaks being allowed for observation of results, but such twelve hours shall be the sum of the run times of the mean number of engines under operation. All times when the engines are at rest due to the shutting off of nozzles, shall not be considered running time. In fixing this time we desire to note that a serious conflagration might demand continuous use of the station for 24 or 48 hours, and that a 12-hour run does not seem to us more than might be called for under conditions which are liable to prevail at any time.

(3) The water discharge shall be from two separate stations on Delaware Avenue, the location of such stations to be determined by the city authorities, and the tests shall be made through orifices of a known size and construction, so that the actual discharge can be computed from tables already in our possession, this discharge to be maintained at a minimum pressure of 250 pounds per square inch at the pumps.

(4) The engines shall be started in such a way as to demonstrate whether or not the capacity of the air storage is sufficient to start all the engines under the most adverse condition, and as the test of starting under actual service conditions, one engine shall be started up under load so that it is discharging water at a maximum pressure within two minutes, the second shall be started in six minutes, the third in twelve minutes, and each additional engine in ten minutes.

(5) From the time at which the preceding engine was started, all engines to be kept in operation until all are started and as long therafter within the 12 hours as may be thought advisable by our committee.

The plant fulfilled the most exacting conditions, and this even under the operation of a staff whose experience at that time with the mechanical equipment had not reached the standard of efficiency existing at the present day.

The entire plant was operated from 6 a. m. to 3:30 p. m., with one unit running continuously 12 hours, 6 a. m. to 6 p. m. The entire pipe service, nearly nine miles, was subjected to the maximum pressure of 300 pounds per square inch for a period of four hours without a defect showing. The entire installation has more than fulfilled the conditions projected by the city authorities and contractors, the plant representing the largest installation of gas engines and the only central power station of its character in the world.

Working Out the Details.

In considering the pipe system, much care was exercised. Steel flanged pipe, cast iron flanged pipe, and extra heavy bell and spigot pipe all received careful study, along all lines. The available appropriation would not permit the use of steel mains; its cost was excessive compared with the use of cast iron. Bell and spigot pattern of cast iron pipe was abandoned, owing to the multitude of lead joints, thus increasing the liability to leakage through bad caulking of joints, or through such a pressure as 300 pounds per square inch. A decision was finally made in favor of cast iron flanged pipe with a solid lead sleeve introduced every 250 feet. In adopting this I feel we have used good judgment, as we have not had one defect develop in the entire 8½ miles of pipe system since it was put into service, three years ago.

The entire system has been subjected to a pressure of 300 pounds per square inch a great many times, in some cases for a steady period of five hours, and again is constantly subjected to pressures varying from 50 to 300 pounds at almost all conflagrations, dependent on fire department manoeuvers, increasing or decreasing the lines of water in service, etc.

In designing the pipe service provisions were made for three fire boat connections along the Delaware river front, and six ways of circulating water, together with the introduction of many valves, so that in case of accident a minimum amount of the service would be thrown out of commission. Again, in laying the service a minimum depth of 7 feet was adhered to, the idea in this being to get below all service connections into buildings, etc., thus placing ourselves beyond disturbance in this direction. At the same time it gave us solid ground for pipe laying.

The three fire boat connections act as a relay water supply to the pipe system, which is entirely independent of the pumping station. All sleeve and valve boxes are built large enough to permit any work in connection with sleeves or valves to be done without tearing up the street.

All pipes and fittings were subjected to a pressure of 800 pounds per square inch (water) before accepted at the foundry, then when laid all pipes were again subjected to a water pressure of 400 pounds per square inch to test accuracy of bolt joints and caulking on sleeves, stuffing boxes on valves and connections to hydrants, etc.; the portion of the line thus tested was then filled in and the ditch repaved.

Drilling the Fire Department.

As soon as the high pressure system was finished the fire department was taken in hand in order to drill the men under the new order of things, and likewise test all the appliances, such as hose, nozzles, couplings, etc. A series of tests were given every week with water thrown into the river opposite the pumping station. These exhibitions were made to make the men of the fire department familiar with this new fire-fighting medium, and in making these tests it was found that the old-time method of handling hose nozzles in throwing a stream of water where maximum pressure from the average steam fire engine rarely exceeds 125 pounds, would not answer at all for the new pumping station, with its delivery and pressure maintained at 300 pounds per square inch; hence to invite the confidence of the firemen in the use of high pressure streams, Mr. John W. Weaver, the constructing engineer of the high pressure system, designed a water battery capable of taking care of any pressure the station is capable of putting on the pipe lines. This battery has completely solved the problem of handling hose nozzles under all pressures, and has given much satisfaction in the fire department. For low pressure use an ordinary stake with steel prongs is used. Mr. Weaver then turned his attention to the quality of hose, couplings, nozzles used in the fire department, and has made tests lasting through an entire year, the result of which has been to increase the efficiency of the entire department. Mr. Weaver, on the strength of these tests, has issued a specification on which the fire department equipment has been purchased for this year.

The prices of the successful competitor were 75 cents per foot for 2½-inch hose, and $1.40 per foot for 3½-inch all cotton rubber lined hose and guaranteed for four years. In addition to the above, Mr. Weaver is at present testing the merits of cotton versus rubber hose in the department, the results of which cannot as yet be determined.

It will thus be seen from the above that a high pressure system is likened to a well organized army. For instance, the artillery is the pumping station, the cavalry the pipe line system, and the infantry the fire department. Therefore, as a chain is no stronger than its weakest link, so all three branches of service for successful operation must necessarily reach a high grade standard of efficiency.

Future of High-pressure Fire Systems.

I believe it to be only a question of a few years when the steam fire engine will be abandoned in large municipalities, and central power station system will be in advance. Even in small towns this is absolutely possible and economical with the use of the gas engine working with illuminating gas, gasoline, or by aid of a producer. Of course a gas engine is not a commercial possibility when operating on illuminating gas at $1.00 per M., and running 8 or 10 hours every day. It is, however, possible with the aid of a producer, or natural gas.

There are today numerous small towns throughout the United States that should consider with favor the gas engine proposition with a view towards a combined distribution and fire system, procuring their water supply from artesian well system. Take, for instance, small towns of from 3,000 to 5,000 inhabitants, with the artesian well system. Two gas engines of 50 horsepower each attached to pumps could readily and very economically fill a stand pipe 125 feet high by 30 feet in diameter, and maintain an efficient supply by operating only 12 hours out of the 24 hours as is usual with steam plants and far more economical; the stand pipe system alone furnishing supply and pressure fully ample to take care of distribution. The supply to stand pipes being cut off in case of conflagration, a 100-pound pressure can be obtained for fire purposes directly through the distribution mains. Such a problem could readily be solved and be economical, as it would dispense with the steam fire engine and render at the same time more efficient service.

The Philadelphia pumping station, as before stated, was to equal in capacity twenty steam fire engines with a capacity of 10,000 gallons of water per minute. We have done this at a cost of $177,000, and what is better still, we maintain it annually for two thousand dollars less than it costs to maintain one fire company of 12 men.

Pumping Station Staff.

The pumping station staff consists of a superintendent, two engineers, two oilers (one engineer and two oilers 24 hours on and 24 hours off), one mechanic (8 hours daily), a janitor (10 hours daily). Each engineer keeps a daily log, the records taken being: (a) reading gas meters three times a day; (b) pump counter readings three times a day; (c) pressures and temperatures three times a day; (d) electric light and power meter three times a day; (e) alarms, services and general occurrences.

Every day the following tests are made: (a) electric currents; (b) cleaning and trying out ignitors; (c) general examination of engines and pumps; (d) individual engines turned over for 5 to 10 minutes' run. Engines and pumps are cleaned daily. The entire plant is turned over once a week. Every ignitor is cleaned once in three months. The three ignition currents are tried before and at every fire service. The air is always pumped up immediately after starting the first engine.

Operation of the Plant.

The entire station is put under way in 7 minutes.

The full pressure on pump, 300 pounds, is obtained in 45 seconds.

The average starting time, per unit, is 1 minute.

The compressed air starting system is fully adequate.

Each compressor is able to run one large engine continuously, independent of the storage tanks.

The total air pressure drop in starting nine units, with the compressor out, is 97.9 pounds average, initial 200 pounds.

The t'me required to place on ignitor is 4 minutes.

The gas supply is clean, uniform and continuous.

The cost of power is approximately proportionate to pumpage.

The total operating cost averaged 12½ cents per 1,000 gallons pumped.

The cost at a large fire is 6 cents per 1,000 gallons pumped.

The entire plant is capable of supplying fifteen 1½-inch streams that may be concentrated on any block within the congested or protected district.

A special battery wagon provided can handle six 3½-inch lines of hose.

The average station pressure for an ordinary fire is 200 pounds.

The pressure drop in 3½-inch hose is about 20 pounds per 100 feet.

INTEREST IN IMPROVED METHODS OF ILLUMINATION.

The recent remarkable growth of interest in the subject of illumination is well exemplified by the rapidity with which the movement throughout the country has spread. Naturally, at the start the subject of better illumination was taken up in the large cities, but the smaller places have in many instances not at all been behind the larger places in the endeavor to give the customer better illumination, and, therefore, better satisfaction for the same expenditure of energy. So rapid has been this growth that the lamp companies find it impossible to fill the orders for the latest types of lamps of a higher efficiency than the old carbon types. As an example as to showing how the movement has spread to the smaller towns, may be cited the case of Middlebury, Vermont, a small place of only 1,900 people. This town, under the efficient managefent of Mr. C. C. Wells, secretary and manager of the company, has perhaps some of the best lighted stores that can be shown anywhere. It is using a very large number of the Gem lamps equipped with proper Holophane reflectors, so that today the store lighting of this small place is on the average much superior to the larger cities. The movement is spreading so rapidly in the town that the management find it impossible to keep pace with the same.

It is interesting to note the attitude of a small place like this compared with the attitude of similar towns a few years ago before the movement toward better illumination had started. At that time, a store was sufficiently well lighted if a number of bare incandescent lamps were hung by drop cords in different parts of the store, allowing the bare lamps to glare in the eye of the customer, as they were placed only slightly above his head, lighting the ceiling fully as well as the counter. Today this attitude has materially changed, and the electric light companies are endeavoring to educate their customers to the difference between light and illumination, which results so materially to their benefit, as the customer ultimately uses more light, gets better illumination and becomes a satisfied instead of a dissatisfied customer.

PROGRESS OF ILLUMINATION IN 1906.

"Never has greater interest been displayed in new methods of electric illumination than during the past year," says the "Scientific American," in the review of technical and scientific progress for the year 1906. "If the promises which are held out by the inventors of metallic filament lamps are fulfilled we may soon witness the passing of the carbon filament bulb. Although the Nernst lamp, on which great hopes were based because it requires only half as much current as the carbon filament, has proved too costly, and the osmium lamp has been found wanting for the same reason and for the additional reason that its voltage of 47 is too low for ordinary circuits, the tantalum and tungsten lamps seem likely successors of the standard incandescent lamp. The tantalum consumes about as much energy as the osmium lamp, but its long filament renders its use possible on a 110-volt circuit and on circuits of even higher voltage. Its useful life of 400 to 600 hours and its maximum life of 1,000 hours and more compare favorably with those of the best electric incandescent lamps in use. The filament is very delicate but able to stand greater variations in voltage than the carbon filament. When broken the ends readily fuse, so that the tantalum lamp's usefulness, although impaired, is not utterly destroyed. The present low cost of construction (about 50 cents), coupled with its high voltage, give it a decided advantage over the osmium filament. Guelcher's iridium lamp is made only for low tensions (24 volts); it consumes, it is claimed, only 1 to 1.5 watts per candlepower, and costs about 87 cents. What its life may be it is impossible to state, inasmuch as no figures have been published. It is open to many of the objections leveled at the osmium lamp. More promising is the tungsten lamp, which is now made by four European firms using as many different processes. The normal tungsten lamp of Just and Hanamann seems to give about 30 to 40 candles at 110 volts and consumes 1.1 watts per candle. Kuzel's tungsten lamp is said to show an efficiency of 1 to 1.25 watts per candle for 19 to 32-candle lamps, with a useful life of 1,000 hours, at the end of which the loss in candlepower is said to be but 10 or 15 per cent. When broken the filament automatically welds together as in the tantalum lamp. The Osmium tungsten lamps have shown from 54.7 to 55.6 candles and from 1.026 to 1.047 watts per candle at 110 volts. Whether these new lamps will fulfill the hopes placed in them can, of course, be determined only by thorough tests under conditions approximating those of actual service. At present the metallic filament lamp is in its experimental stage. The necessity of using the tungsten lamp in the inverted vertical position may perhaps be regarded as a defect; yet quite recently the vertical incandescent gas mantle has invaded an extensive field hitherto monopolized by the electric light."

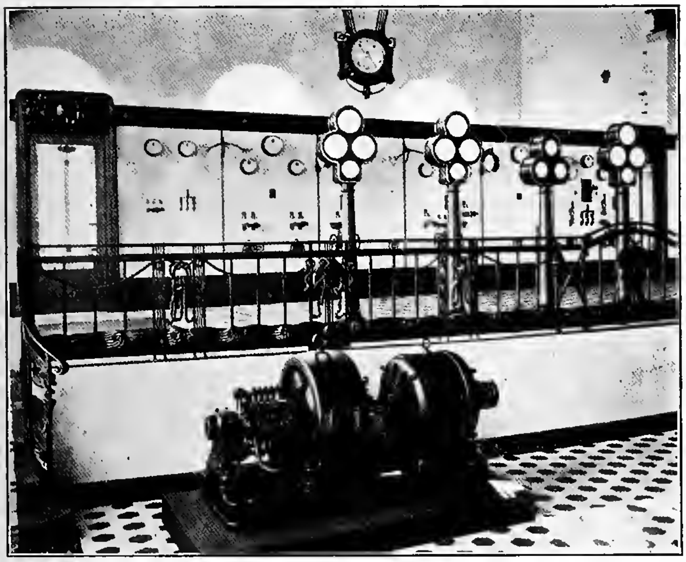
AMERICAN STEEL TRADE.

Never, either in America or elsewhere, has there been such an extraordinary condition as that in the steel industry of the United States. The mills are already crowded with orders to such an extent that their total output up to the end of 1907 will barely serve to represent the demand; and the mills which are devoted to the production of structural steel are overloaded with work and must be pushed to the very utmost to fill orders that are due to be delivered in the coming Spring. Even more urgent conditions prevail at the plate mills, the demand for whose output is to be attributed very largely to the growing popularity of steel cars. These mills have sufficient orders on their books to keep them going at full pressure for practically the whole of 1907. Nobody would have predicted at the time of the formation of the United States Steel Corporation a few years ago that within so short a time not only that great aggregation, but also the independent concerns, would be taking orders for materials which could not possibly be delivered for twelve months or more from the date of signing the contracts.

ELECTRICITY IN THE OPERATION OF THE TELTOW CANAL.

In Germany canal towage by electricity has recently been demonstrated as commercially successful, particularly on the Teltow Canal near Berlin. The further application of electricity to the navigation of inland waterways is considered most desirable. The Teltow Canal is 23.5 miles long, and connects the river Spree with the Havel at Glienicker Lake. At the river Spree about nine miles from Berlin, near Drunau, the canal starts with a width of sixty-eight feet and a depth sufficient for canal boats drawing nearly six feet of water and having 1,200,000 pounds register. The boats usually employed on this canal are 110 feet long and 8.6 feet wide. The canal has a depth of eight feet at low water in the middle and seven feet at the sides.

Between the Havel and the Spree there is a difference of level of about ninety-seven feet and a system of locks has been installed about five miles from the Havel, consisting of two locks placed side by side with a wide masonry wall between them. A system of conduits has been provided within this wall for filling and emptying the locks with a minimum amount of water, the arrangement being such that the water used by a boat going down the canal may be emptied into



SWITCHBOARD AND EXCITER SET AT THE CENTRAL POWER STATION OF THE TELTOW CANAL.

the other lock for raising a boat going in the opposite direction. During the dry season, water is pumped from the lower to the higher level by means of a centrifugal pump, electrically, operated, having a capacity of one cubic meter a second. There are four hoisting gates at the locks, each of which is operated by a 15-horsepower motor, running at a well as the equipment for supplying the necessary curspeed of 600 revolutions per minute. These electric motors, as rent, were installed by the Siemens-Schuckert Company of Berlin. The motors are of the three-phase induction type, operating at a pressure of 200 volts; and can raise the gates to their full height of 8.27 meters in one minute. Electromagnetic brakes are provided and the gates are counterbalanced with variable weights, the electric motors being employed for both hoisting and lowering.

During high water it is necessary to conduct a portion of the water from the higher to the lower level, and this is done by means of a gate in the middle wall, operated by an eight-horsepower induction motor running at a speed of 580 revolutions per minute.

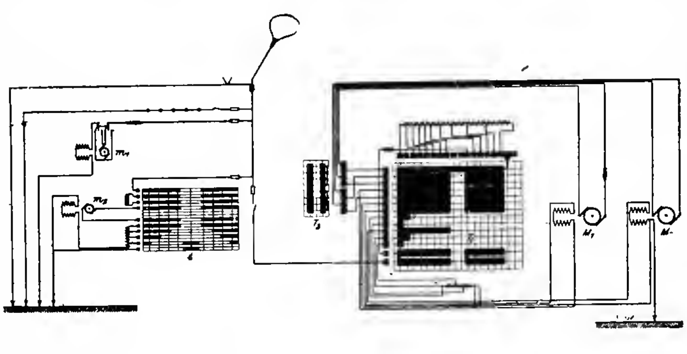
The power station of the Teltow Canal is equipped with a 300-horsepower reciprocating engine installed at that end of the station nearest the switchboard, together with two steam turbines of the Zoelly design, constructed by Escher Wyss & Company, of Zurich, Switzerland. Each of these turbine units consists of a high-pressure and a low-pressure turbine, provided with five runner discs, and can develop a total of 1,000 horsepower. The capacity of the plant is therefore 2,300 horsepower. Space has been provided for other units to be added as additional power is required.

The reciprocating engine is coupled to a large revolving field alternator and a multi-polar direct current dynamo on the same shaft. Each of the 1,000 horsepower steam turbines is direct-connected to a three-phase alternator of the revolving field type, generating at 6,000 volts at a frequency of 50 cycles per second. On the same shaft of each is mounted a Siemens-Schuckert compound-wound, direct-current dynamo, of the inner-pole type, supplying continuous current at a pressure of 600 volts. The alternators driven by the steam turbines have a rating of 650 kilowatts, and the one driven by the reciprocating engine, a rating of 230 kilowatts. The direct-current machine connected to the engine has a capacity of 110 kilowatts, while the two continuous-current turbine driven dynamos have a capacity of 200 kilowatts each.

In connection with the steam turbines, jet condensers are employed and three-phase motors are utilized for driving the pumps. A vacuum of ninety-five per cent. is maintained, as there is plenty of condensing water. Steam is supplied to the high-pressure turbine at a pressure of 180 pounds per square inch, and is superheated to 300 degrees centigrade. There are four water-tube boilers, each of which is provided with a superheater which can be utilized or not, as desired, the latter having a heating surface of sixty-five square feet, supplying 8,000 pounds of superheated steam per hour. Each of the boilers has a heating surface of 2,200 square feet, and supplies steam to the turbines at the rate of 13.4 pounds of steam per horsepower hour, this being the consumption of the 1,000 horsepower turbine unit at full load. At half load the steam consumption is increased to 15.6 pounds. At three-quarters load the consumption is 14.3 pounds.

Near the end of the Teltow power station, opposite the switchboard, are located the exciter units which consist of three-phase induction motors direct-connected to shunt-wound direct-current dynamos rated at 32 kilowatts, supplying the exciting current at 65 volts. The three-phase induction motor of each exciter set is supplied with alternating current at 230 volts, and drives the generator at a speed of 960 revolutions per minute. A storage battery has also been provided for lighting the station and exciting the alternator fields when desired, or in case of emergency. This accumulator plant consists of 36 storage cells, each having a capacity of 126 amperes for a period of half a n hour. In this station there is an overhead traveling crane of sixteen and one-half equipped with two rotary converters each having a capacity tons capacity. At the eastern end of the canal a substation has been provided which is equipped with two rotary converters each having a capacity of 150 kilowatts and operating at a speed of 1,000 revolutions a minute. Space is also provided for a third unit to be installed when desired.

For the operation of locomotives towing the canal barges, and the towing carriages at the locks, continuous current is



LOCOMOTIVE CONNECTIONS.

utilized, while alternating current is used for lighting purposes and all auxiliary work.

Various types of engines, motors and hauling methods have been tried on this canal. A 60-horsepower Daimler alcohol motor was placed in one of the boats and was found to take .01 kilogram of alcohol per ton-kilometer (0.035 pound per ton mile). This would result in a cost per ton kilometer of one-twentieth of a cent with alcohol costing five cents per kilogram (.08 cent per ton-mile).

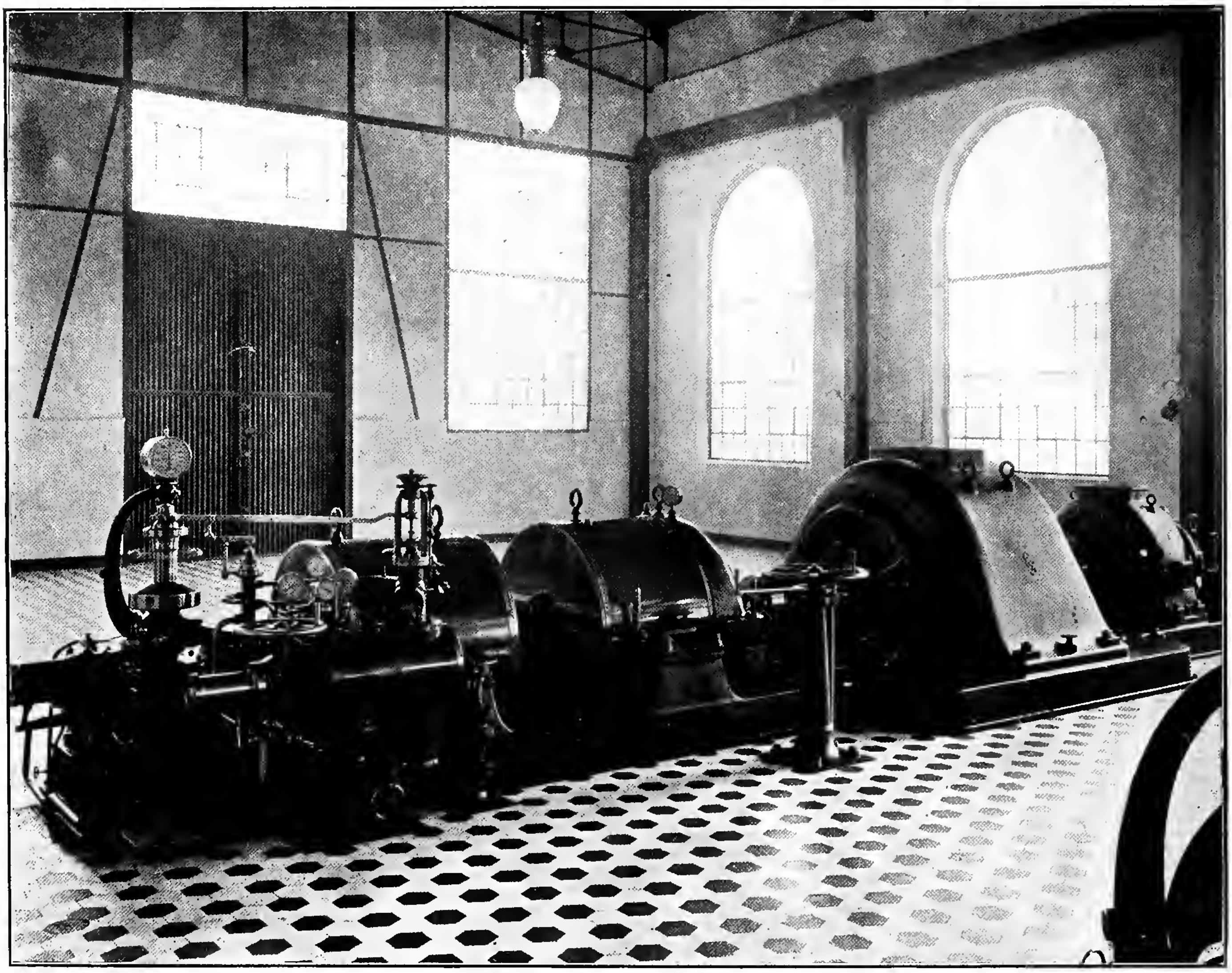
With oil-fired boilers and a steam engine, the cost of operation when towing two boats with a load of 2,400,000 pounds and a speed of two and a half miles per hour, would be .01 cent per ton-kilometer (0.16 cent per ton-mile) with oil costing less than a cent per kilogram. A steam oil-fired boiler tug was found to take 1.1 pounds of fuel oil per horsepower hour, the boat taking 100 horsepower at the speed above mentioned.

An electric tug was also tried at the speed of two and a half miles per hour. The boat was found to have an efficiency of twenty-two per cent., the energy consumption being nine kilowatt-hours per ton-kilometer (14.5 kilowatt-hours per ton-mile). This boat which was called the "Teltow," was of the triple-screw type and was provided with a storage battery of 220 cells, having an output of 244 ampere-hours for a five-hour discharge. The battery was located in three of the six compartments of this boat, and had a total weight of 26,000 pounds.

Each of the three propellers was provided with a direct-current series motor, connected to the shafts by a flexible coupling. The three motors were placed in one compartment. The motor driving the center shaft had a capacity of 25 horsepower and ran at a speed of from 300 to 500 revolutions a minute, while the two motors driving the side propellers developed 20 horsepower each.

For collecting the current to supply the motors of the electric tug double trolley poles were tried but were not very successful. The Lombard Gerin motor-driven trolley was also used, which gave better success, although it was noted that the trolley-collecting motor would tend to lag behind when the boat was operating at full speed under a light load, while it would travel in advance of the tug when several heavy canal boats were being towed. On account of the high cost of operation and low efficiency, the electric tug was given up in favor of a locomotive towing the boats from the side of the canal on a specially constructed track.

The Siemens & Halske canal locomotive was designed to operate on a track of one meter gauge, hauling two loaded canal boats of 600 tons each at a speed of 2.5 miles per hour. This locomotive was found to require an energy consumption, at the above speed, of 5.5 kilowatt hours per ton-mile, while with a speed of 3.1 miles per hour, the energy consumed was found to be 8.5 kilowatt hours per ton-mile. It is stated that the mean efficiency of the locomotive was sixty-five per cent.



STEAM TURBINE, CENTRAL POWER STATION OF THE TELTOW CANAL.

This electric canal haulage locomotive is provided with a four wheel truck, equipped with two 8-horsepower electric motors of the series direct current type, and a trailing pair of wheels supporting the rear end of the locomotive with the guide arm and drum for the tow line. The hauling motors are connected by two sets of gears to the axles, operating at a speed of 800 revolutions a minute, with a terminal pressure of 500 volts. The guide arm for the tow line is manipulated by a 3-horsepower motor connected with a screw to the arm through a pair of bevel gears. This motor operates at a speed of 1,460 revolutions per minute, and is also used for driving the drum which winds up the towing rope, consisting of a 10-millimeter wire. The coupling of the drum is of the friction type, so arranged that when a pull of 2,500 pounds is exceeded, slipping will occur. Therefore, when starting a heavy load, the locomotive will take its load gradually, as the drum will slip until it is partially under way.

The locomotive weighs 16.5 tons. The greater part of the weight is carried by the wheels on the side toward the land, there being 4,200 pounds for each of the driving wheels, and 2,700 pounds for the trailing wheel. On the side toward the canal, the weight on the trailing wheel is 850 pounds and on each driving wheel 3,000 pounds.

The arrangement of the weight of all the auxiliaries on the side of the locomotive away from the canal, as well as the placing of the driving motors as far as possible on that side, is on account of the tendency of the pull on the tow line to tip over the locomotive. In order to overcome this to a still greater degree the rail on the side nearest the canal is raised somewhat higher than the inner rail.

For handling the boats at the locks a trestle construction was built, extending 455 feet along the middle of the canal and provided with two parallel tracks. Electrically-operated crane cars, each weighing 3,300 pounds, run on these tracks and haul the boats into and out of the locks. The motor equipment is sufficient to haul a boat in a half hour from a point about 350 meters from one end of the lock to an equal distance at the other end. The two locks can be operated at the same time with two boats in each lock, thus giving a maximum tonnage of about 65,000 in twenty-four hours.

OPERATION OF A ROTARY CONVERTER SUB-STATION.

In an address delivered before the Western Society of Engineers, Chicago, Dec. 21, Mr. Ernest F. Smith discussed the operation of a rotary converter sub-station from a practical point of view. Among his remarks were included the following:

Brush Economy.

The question of brush economy is one of extreme importance, especially when considered in connection with the operation of a large system, such as that of the Chicago Edison and Commonwealth Electric companies. In these systems there are in operation about 70 rotary converters and when we consider that the cost of a complete set of brushes for a rotory converter ranges from $40 for a 500-kilowatt machine to $180 for a 2,000-kilowatt machine, which means that the cost of brushes only of the converters in operation in the system mentioned is slightly in excess of $4,000, it will readily be seen that brush economy is quite an important subject.

This matter has been given a good deal of careful study and by careful attention to systematic maintenance of brushes, commutators, and collector rings, the life of a set of direct-current brushes has been increased until it is from four to five years at the present time. This figure includes wearing out and destruction of brushes from all causes, including the wear on commutator, sanding, cracking due to vibrations, explosions due to rapid expansions and burning off of pigtails or unsweating of pigtail caps due to poor contact or defective distribution of load between brushes.

Considering wear and loss due to sanding only, the life of a direct-current brush is equivalent to about eight years, and considering wear only the life would be about ten years for an alternating-current copper brush and twenty years for a carbon brush. It will thus be seen that, considering twenty years as the maximum possible life and four years as the actual life obtained in practice, that the percentage of life in the Edison and Commonwealth systems is about 25 per cent. This is considered to be comparatively high.

Setting Brushes.

There are 430 brushes on a 2,000-kilowatt machine and 112 on a 500-kilowatt machine, necessitating constant care and attention in order to keep them in prime condition. The matter of properly setting the brushes is of the utmost importance. The brush-holder studs on the direct-current side should be accurately and equally spaced all around the commutator and a line of brushes of a given polarity across the commutator should be absolutely parallel with the commutator. The copper brushes on the alternating-current side studs should be staggered with reference to each other, so as to cover the entire commutator surface, instead of allowing the brushes of a given polarity to track and form grooves.

Experience indicates that a carbon brush tension of about 1 1-3 pounds per square inch gives most satisfactory service and contributes to the life of the brush and commutator. The copper brushes on the alternating-current side give very satisfactory results when the tension is from 1½ pounds with a 500-kilowatt to 2 pounds with a 1,000 or 2,000-kilowatt unit. The current density in the contact surface of the rotary-converter brushes in use in the system referred to ranges from 27.6 amperes per square inch for a 500-kilowatt rotary to 33.3 amperes per square inch for 2,000-kilowatt rotary on the direct-current end and from 50 to 57 amperes per square inch for the laminated copper brushes on the alternating-current end.

The equivalent of one complete row of carbon brushes is treated with dynamo oil and distributed in the brush holders throughout the commutator in such a manner as to bear on the entire commutator surface. This is for the purpose of effectively lubricating the commutator, thereby reducing friction and noise in operation. The method of treatment consists of immersing the carbon brushes in boiling oil for a period of about an hour, after which they are removed and dried at a temperature of 200 or 300 degrees F. for a period of half an hour or more. The commutator surface is frequently wiped with a clean piece of cheesecloth, and when the machine is about to be shut down and is well heated up a piece of cheesecloth bearing a trace of oil is wiped across the commutator, with a clean, dry piece of cheesecloth bearing upon the commutator surface immediately back of the oiled cloth. This method of maintenance will keep the commutator and brush surfaces in good condition.

The alternating-current brushes are staggered on the ring, so as to get an even wear and it is found with good care that it is not necessary to retrim them or seriously disturb their adjustment more frequently than about once a year. They are then properly trimmed and beveled and replaced on the machine. A very light application of vaseline or machine oil from time to time, while the machine is in operation, will effectively prevent cutting of the ring or excessive wear on the copper brushes. This treatment will preserve the commutator and collector rings in good condition, requiring the turning down of the collectors at intervals of about five years, and turning of the direct-current commutators at intervals of from five to ten years. As the cost of turning down commutators and collector rings ranges from $58 for a 500-kilowatt machine to $140 for a $2,000-kilowatt machine, it will readily be seen that there is room for substantial saving by the proper care of these parts.

Oil Economy.

In connection with oil economy statistics show that the average consumption of oil for each machine in the system during the past year has been 3.2 gallons. This is equivalent to a life of four years for the oil. The temperature of the bearings is very closely observed with reference to the temperature of the surrounding air, and in all cases where the rise in temperature exceeds 15 degrees C. the oil is promptly filtered and replaced in the bearings. This will usually result in lowering the temperature. If the temperature still remains high the cause is further investigated and removed.

The average rise in temperature of all bearings in the Edison and Commonwealth systems at the present time is approximately 14 degrees C., the minimum being about 7 degrees C. A portable filter is used for the purpose of filtering oil and is sent from one substation to another as required.

Blowers.

It is extremely important that the condition of the blower equipment for the air-blast transformers and regulators be properly maintained at all times, as the shutting down of the blower would seriously affect the operation of the converter units at times of heavy load, and on account of the serious overheating of transformers and regulators which would follow, it would soon become necessary to shut down the main units if the air blast were not restored.

The screens used for cleaning the air are regularly inspected and washed and blown out, and the ventilating ducts of the transformers and regulators are thoroughly blown out and cleaned from once to twice a week.

Starting and Synchronizing.

In connection with the operation of such substations, accurate synchronizing is about the most important specific operation required to be performed in a substation. Any serious inaccuracy in performing this operation will result in fracturing the castings of the potential regulator, or if there is no regulator used in connection with the unit, the armature conductors of the converter are likely to be drawn out of their slots or the transformer structure seriously strained.

In connection with the regular shutting down of rotary converters which are normally started from the direct-current end, it is extremely important that the field circuit of the converter should be left closed until the machine stops rotating. This is necessary in order to thoroughly demagnetize the transformer cores and it is partially true in connection with diametrically connected units.

Under certain conditions the converter may stop with the direct-current brushes resting on the commutator bars which are connected to the same armature conductors to which the collector rings are connected, which are in turn connected to the terminals of a given transformer coil. This places this transformer coil in shunt circuit with the armature windings of the converter. If this transformer coil has previously been demagnetized, its impedance will be sufficient, upon throwing the starting current into the armature of the converter, to prevent an undue amount of current from passing through the transformer instead of through the armature of the converter, and the machine will start. However, if the transformer had not previously been demagnetized and the field circuit had been opened at a time when the magnetization of the transformer coil was at a maximum in the same direction as would be caused by the passage of the starting current through the transformer coil, then there would be practically no impedance and the practical equivalent of a short circuit would be connected to the direct-current brushes of the converter, thus rendering it impossible to start the machine. In this case the brushes should be lifted from the alternating-current rings, and the transformer momentarily connected to the high-tension line, thus changing its magnetic state to a more favorable condition.

Starting After a Shut-Down.

In connection with starting up the system after a general shutdown, if the shutdown has been of such long duration as to result in fully discharging the storage batteries, thereby leaving many of the substations without an adequate source of supply for starting from the direct-current end in the regular way, the procedure employed in some of the large systems is to start a large group of converters from a turbine or prime mover, from rest with low-frequency, low-voltage multi-phase currents. The field circuits and direct-current switches of the converters are left open and the unit is connected on the alternating-current side only. A direct-current voltmeter is connected to the direct-current terminals of the machine and as soon as the turbine begins to rotate slowly, slight vibrations of the voltmeter needle will be observed. This action will continue, gradualy increasing in amplitude until the rotary begins to turn. After the converter has made a few complete revolutions the voltmeter needle will have discontinued vibrating, and if the field circuit has not been closed at the proper instant, will have taken up a fixed position either above or below zero, indicating correct or incorrect polarity. The field circuit should be closed as the needle is swinging past zero in the direction of correct polarity, thus locking the converter into synchronism with the generator and insuring correct polarity if the operator is skilful in performing the operation.

The power factor is adjusted to unity by means of the field rheostat, and as soon as the converter potential is equal to the system potential, the direct-current switches of the converters are closed and other converters are started from the direct-current side. They are then synchronized with the low-voltage, low-frequency line, and other generators are synchronized under similar conditions at the power house. Another stage of acceleration then takes place, and this action is repeated until the entire system load has been raised to the normal direct-current potential.

In our operating practice covering this emergency procedure, machines of a rated capacity of 11,000 kilowatts have been thus started from rest, and machines of additional capacity of 7,500 kilowatts were immediately started, receiving direct current from them, after which they were synchronized with the low-voltage, low-frequency lines. Additional machines of a rated capacity of 11,500 kilowatts were thrown onto the line, merely as a drag, making a total of 30,000 kilowatts connected to one turbine when the final stage of acceleration was started. As the turbine used was one of the older units, it is believed that with a new unit of greater capacity a much larger load could be brought up from rest.

In some of these trials the time required to perform all operations from the time the converter started turning until the second converter had been started with direct current received from the first and synchronized and cut in with the low-voltage, low-frequency line, was as low as 30 seconds. The average time, however, is considerably higher.

The time required to start machines from direct current and under regular conditions ranges from about 51 seconds for a 500-kilowatt machine to about 1½ minutes with a 1,000-kilowatt machine, not including time required for regular operation. It is not often necessary to operate the regulator after a shutdown, but in case it should become so, under extreme conditions necessitating running from the neutral point, the time for a 500-kilowatt machine would be about 1 minute and 50 seconds, and for a 1,000-kilowatt converter about 2 minutes and 27 seconds.

SOME FEATURES OF CONDENSER INSTALLATION AND OPERATION.

As a result of the prominence attained by the steam turbine in the steam power installations and also on account of its use in larger types of reciprocating engines, the question of the correct design and installation of condensing apparatus has, of course, been closely studied by engineers.

Condenser installations require great care in design, if they are to meet the actual conditions existing at the place where the condensing apparatus is to be installed, and consequently power users who contemplate putting in condensers, should make a close study of these local conditions. If they are not themselves fully qualified to pass upon the subject, it is advisable for them to consult an engineer who thoroughly understands condenser applications. The matter is too important to hazard a guess, for there is nothing about a plant which can cause more annoyance than a poorly designed condenser installation. For example:

The greatest care is necessary in the design, construction and maintenance to keep the system free from air leakage; for the chief difficulty in maintaining a vacuum arises from such leakage. The leaks are inward, therefore invisible and hard to locate. The designer or the constructor often does not realize all that is here implied, judging from the results sometimes produced.

There are, in addition, a number of points to be observed, which, if carefully followed, will save an endless amount of trouble and lead to substantial economy in the operation of the plant.

The application of two or three coats of elastic paint on clean surfaces will eliminate many of the leaks in the exhaust pipe lines, but there still remain several places for air leaks which are not so easy to remedy. The stuffing boxes on the rods and exhaust valve stems of the low pressure cylinder are apt to be sources of trouble. This, however, can easily be eliminated by using double metallic packing on both rods and valve stems, and piping the steam from the receiver to the space between the two sets of packing, thereby forming a steam seal on the rod. With such a seal it is impossible for air to leak into the system through the stuffing boxes.

Another source of air leakage into the condensing system is through the water supply. The stuffing boxes on the pump should always be sealed with water, and all joints on the suction line must be made up tight. The line should be carefully painted before burying it in the ground. The higher the suction lift, the more care should be exercised in this work, because all air drawn in through the suction line which is subject to vacuum is discharged directly into the condenser. The fact that the pipe may be buried several feet under ground does not protect it from air leakage.

A further source of air being drawn into the condensing system is with the water through the suction line of the pump. All suction lines should be submerged not less than six feet and more if possible. The end of the suction pipe should be increased to at least twice the diameter of the pipe to reduce the velocity of the water entering the line. In a well 12 feet in diameter, a 12-inch suction line was run to a centrifugal pump. The end of the pipe in the well was submerged 8 feet, but not increased in diameter. It had been observed that dry saw dust, thrown on the surface of the water, was sucked in small eddies down into the suction of the above pump. If saw dust was drawn down, it is clear that air was drawn with it. The amount of air coming down the tail pipe of the barometric condenser, discharging into the hot well, showed plainly that there was air leakage somewhere in the system, but the source of it was not located until the action of the water in the well was discovered by the engineers in charge of the plant. The remedy for this condition was to enlarge the diameter of the suction pipe in the well.

RIVER TO LIGHT PARIS.

$4,000,000 to be Saved by Employing Long-range Water Power.

A colossal scheme of power development is said to be on the point of realization in France. It is proposed to utilize the river Rhone for the development of electricity for the city of Paris. Light, heat and motive power are promised at the cheapest rate in the world.

The originator of the idea is an engineer named Mahl. His plans have the indorsement of the National School of Highways and Bridges, and of the Society of Electrotechnicians. The enterprise is so assured that contracts for the delivery of current in Paris at an early day are already being negotiated.

The water is to be drawn from the Rhone at Grezin, not far from the famous Porte du Rhone or falls of Bellegarde, where the river, already of great volume, draining as it does Lake Geneva, plunges for 300 yards or thereabouts through a chasm which it has scored for itself in the solid rock.

The water diverted through a sluiceway will be impounded to the amount of 2,000,000 cubic meters, or about 2,666,000 cubic yards, on the level of Collonges and returned to the river through a double tunnel of 4,500 meters, or about 4,750 yards, with a fall of 65 meters. This will furnish a flow, it is calculated, equivalent to 100,000 horsepower.

The electric current is to be developed by 48 dynamos divided into groups, each driven by a turbine of 10,000 horsepower. The lines to Paris will be as direct as possible; the distance is between 250 and 300 miles; but no special difficulties are expected. Some long lines of delivery in America and one in Sweden, supplying Stockholm from a distance of 600 kilometers, or 360 miles, have been studied in the preparation of the plans, and are quoted as showing that the enterprise is entirely possible.

It is calculated that the delivery of the net electric power from these works in Paris as compared with the development of the same energy on the spot by coal consumption will effect a net annual economy of about 20,000,000 francs, or $4,000,000.

ELECTRICAL COOKING DEVICES EXHIBITED BY GENERAL ELCTRIC COMPANY AT THE CHICAGO ELECTRICAL SHOW.

Last year the Chicago public witnessed the first elaborate public display of devices for cooking and heating by electricity. This year the display is much larger and more elaborate; particularly does the General Electric Company cover the ground in a comprehensive manner. It is perhaps unnecessary in these columns to enumerate all of the devices now being regularly offered to the public for the use of electricity in heating and cooking. Particular attention has been devoted by this company to demonstrating the indestructibility of its cooking devices.

The public is, of course, always attracted by any exhibit where things are cooked and distributed free, but the keen interest shown in the devices themselves is something of an indication of the popular demand for such things.

The electric percolators, chafing dishes, flat irons, and cereal cookers have assumed the dignity of a standard product, but there is a vast growing demand for ovens, broilers, frying pans, and corn poppers, as well as electrical heaters of various sizes designed especially for home and office use. The uses of all these and more are regularly demonstrated at the General Electric Company's exhibit at the Chicago Electrical show.

The JOURNAL OF ELECTRICITY POWER AND GAS

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EASTERN AGENCIES

NEW YORK ....
CHICAGO ....
ST. LOUIS ....

WESTERN AGENCIES

LOS ANGELES ....
PORTLAND ....
SEATTLE ....

Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," with which is incorporated "The Engineers', Architects' and Builders' News."
Entered as second-class matter at the San Francisco Post Office, August 15, 1899.
Entered as "The Electrical Journal," July, 1895.
Entry changed to "The Journal of Electricity," September, 1895.

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EDITORIAL.

University Training and the Engineering Profession

Great changes have been made during the last ten years in the arrangement of the technical courses in our leading engineering institutions. Formerly the student was given practically no option in the choice of studies for each year. He found it necessary to pursue the work as given in the course of instruction leading to the degree he desired to obtain, and considered himself fortunate if by passing up a study or taking extra hours he could find a small amount of time to devote to some subject in which he was especially interested. At the present time, however, in most of our engineering colleges it is possible for the student to select as he desires the particular courses which interest him most. This is especially true of the last two years of the regular four years' course. It is, however, quite important that the first two years of the university work shall consist of fundamental or foundation courses which are not only a necessary preparation for the last two years, but have a distinct value in training the mind of the student.

Many young men are ill prepared upon entering the university to wisely select the courses best suited to their needs. There is no doubt that the system which is in vogue at the present time of making the first two years' work rigid as regards the courses which the student may take, considering the requirements of admission and the vast amount of ground to be covered before one may enter what is termed professional work proper, has been a decided advantage to many students. By having their courses of study planned by those who have had much experience in choosing the subjects necessary to fit a student for actual practice of a profession, much valuable time has been saved.

There are two sides to this question of definitely prescribed courses. In following out a rigid course of a study, the fact that a certain result has to be obtained is often lost sight of by the student. He is compelled to take the subjects because they are in the course of study and therefore gives little thought to the training that each is meant to give. If unfortunately he has imbibed the thought of practical ideas from some unknown influence, everything theoretical appears to him as useless, and as a result perhaps the very thing which he will need most in future life is lost. This might not have happened had the student been led to choose the subjects himself, having had the advantage to be gained from pursuing a certain course clearly pointed out by an experienced advisor.

The practical fever in many instances destroys the very influence that tends to place the college bred, professional man in the long run ahead of his more experienced practical brother who has worked himself up by successive promotions in some trade or profession. Any one of average ability, by steady application and strict attention to duty, may become a first-class foreman or superintendent without investing, what would be a small fortune to a young man beginning life, in a college education. If this is the end in view, by all means let the young man invest his money in some steadily growing company. A few thousand dollars' worth of stock will obtain for him more practical use than the same amount invested in a college education. But it is to be hoped that this is not the end which most students have in view. Only the thoroughly trained, conscientious, high idealed man can be an investigator, a successful inventor or a master in his profession.

The development of masters is what a college education is for. The master of a profession must not only know how to apply the theory he has studied to obtain the desired practical results, but what is much more important, he must be able to evolve new theories by studying and analyzing practical results, which theories will lead to new conclusions, thereby obtaining more and more control of the natural forces with which he is surrounded. In the last two years of the university work, the courses should be surrounded by the right influences and the personality of the instructors should be such as to indicate to the student the training each portion of the course is meant to give, and to impress the fact upon the student's mind that no one subject but all are the most important. This spirit prevailing throughout all the courses would harmonize all the departments of the university and do much to surround the student with the influences that do so much to form the best education.

BOOK REVIEWS.

The British Institution of Electrical Engineers has issued Part 12 of its Science Abstracts for the year.

These publications, published monthly, are devoted to short abstracts of all important scientific and engineering articles appearing in the technical press of the world.

The names of authors and publication in which they appear are also given.

The Co-operative Electrical Development Association have issued in attractive pamphlet form, the article by Charles Nathan Jackson on the "Organization and Conduct of a New Business Department, Suitable for Central Stations in Cities of 50,000 Population and Under."

This article received first honorable mention by the above association, and was of such merit that it was published in full in a recent issue of the "Journal."

"Self-Propelled Vehicles," a practical treatise on all forms of automobiles, by James E. Homans, A. M. Fifth revised edition, entirely rewritten. New York. Theo. Andel & Co., 63 Fifth Ave. 1907.

In this revision of previous editions the above book fulfills the requirements of the motor vehicle owner, operator and repairer. The author has emphasized the practical aspects of motor vehicles of all powers, confining his space to the discussion of matters fundamental in construction and management. Theoretical matters, which are important only in a general sense to designers and builders, are introduced only where good explanations positively require them. All subjects are fully illustrated, and its standard as regards paper, type work and binding is very high.

TRADE CATALOUGES.

The Holtzer-Cabot Electric Co., of Boston (Brookline), Mass., have sent out several small leaflets descriptive of their electric apparatus. They apply to motors for alternating and direct current, and to motor generator sets of small size.

The electrical department of Allis-Chalmers has issued revised Bulletin No. 1045, relating to rotary converters. The illustrations are up to the usual Allis-Chalmers standard, and the descriptions of various parts complete and to the point.

General Electric Co.

Descriptive bulletins on following appliances have been recently issued by the General Electric Co. Supply department:

No. 4469—Pocket Instruments for Direct or Alternating Current, supersedes No. 4378.

No. 4472—Mercury Arc Rectifiers supersedes No. 4411.

No. 4477—Accessible Manhole Junction Boxes, Type SD, supersedes No. 4326.

No. 4474—G. E. 76 Railway Motor.

No. 4476—Type PP Dial Controllers.

No. 4478—Parts of Type K Series Parallel Controllers, supersedes No. 7560.

No. 4479—The Toledo & Chicago Interurban Single-phase Railway.

No. 4480—Pipe Thawing Transformers.

No. 4483—General Electric Automatic Time Switch, Type T, for Alternating and Direct-current Circuits.

Electrical Instruments.

The Wagner Electric Mfg. Co., of St. Louis, have issued a catalogue relating to a complete line of electrical instruments. Considerable space is devoted to the general principle of operation and construction of the various types which are at the present time in general use.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The 213th meeting of the American Institute of Electrical Engineers will be held in the Auditorium of the Engineers' Building, 33 West Thirty-ninth Street, New York City, on Friday, January 25, 1907, at 8:15 p. m. The following paper will be presented by Lewis B. Stilwell and Henry St. Clair Putnam: "Substitution of the Electric Motor for the Steam Locomotive." The paper will include:

1. Presentation of certain facts established by experience in the operation of elevated, subway and interurban lines by electricity.

2. Discussion of comparative cost of operation by steam and electricity applied to railways in operation, and including both passenger and freight service.

3. The importance of standardizing electric railway practice.

4. The question of frequency in the operation of railways by alternating current.

Members of the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers, the New York Railroad Club and the Transportation Club are cordially invited to attend this meeting.

THE UNITED STATES LARGEST CONSUMER OF RUBBER.

With about $50,000,000 worth of rubber imported into the United States last year, this country has become the consumer of more than one-half of the rubber crop of the world, according to the Department of Commerce and Labor. The popularity of the bicycle and the automobile, coupled with the increased use of electricity in the daily affairs of the people, are responsible for the increase, the department experts say. Brazil is the chief contributor to the supply for the United States, but the growing demand, together with the reckless manner of collection in South American forests, has led to the establishment of rubber plantations in India, Ceylon and even in the Philippine Islands. Indications are that the rubber-growing industry in the Philippines and in the Hawaiian Islands will become very profitable.

FUEL TESTS.

As evidence of the co-operation between theory and practice which happily exists in the United States we may mention that a series of investigations of great interest to manufacturers and coal exporters is to be undertaken at the State experimental station which has been quite recently established at the University of Illinois. It has been arranged that a rather elaborate series of experiments with various Illinois coals should be run so as to determine the most economical method of using them. For this purpose tests will be made on the fuel under boilers for power plants, in gas producers, in heating boilers; and there will also be made chemical and calorific tests. In the State of Illinois there has of recent years been a great advancement due to the development of its natural mineral resources and also to the exceptional facilities for transportation. Several of the leading engineering socities were asked to co-operate with the State Geological Survey and the University departments of applied chemistry and mechanical engineering. A preliminary conference was recently held and arrangements were made for the tests to be carried out.

HOW A GAS MAN MAY SHARE THE SUCCESS OF HIS COMPANY.*

By Charles S. Ritter.

I refer to any employee of a gas company, but particularly to the man who is already an executive; the manager or any one of his assistants.

This topic is almost self-evident, because the gas man usually does share the prosperity of his company. Good men are too scarce and too much sought, for it to be otherwise. It is not, however, of the man who can better his position by changing, but the one who can make his position better by staying by it, that I wish to speak.

Some of us, perhaps, are looking forward to changing as a means of widening our experience and amplifying our education. The superintendent in a small plant believes opportunities are better in a large one, and the assistant in a large plant wants to be superintendent in a smaller one for the same reason.

When the superintendent of a small plant goes to a large one, the first thing that impresses him is the narrowness of his field for observation and experience. He is held down by a multitude of duties in his own department, and if he attempts to go beyond he is likely to tread on the toes of a brother superintendent. On the other hand, the assistant in a large plant, who leaves to become superintendent or general manager in a smaller one, can see at once a limit to his income, because of the restricted earning power of a small plant. There is this much to say, however, in favor of the small plant—it is practically the only place to get an all-around education in the elements of the business—it is the best school.

It is prudent for the man to consider carefully the prospects in his present position before making a change, and whether he has developed them to their highest potential. I have known gas men to study hard on some subject out of their own department, or foreign to their business, in a vain endeavor to better their condition, in the meantime allowing subordinate associates to be promoted ahead of them because of lack of application and appreciation of possibilities in their present situation.

In a growing city it is very likely the gas man will get the most out of his business by remaining with his present company and growing up with it, not in immediate financial benefits, perhaps, but in ultimate net results, social and financial.

If I were the owner of a gas company I should try to get men whom I could trust to interest themselves in building up a strong and safe institution and who would look forward to remaining with it and sharing in its success, both as a matter of personal pride, and because it would yield them ample profit.

There can be no greater incentive in promoting the company's welfare than to give them a wide latitude in which to apply their own methods. One is bound to make his own plans work, and although the plans themselves may be somewhat inferior, they will succeed better if vigorously pursued than though they were originally very good but poorly executed. No compensation is greater for a man than to watch his own plans succeed.

The gas man who looks forward to making a change may work selfishly for the largest immediate profit or smallest expense account he can show, for use later to advertise himself. He may adopt methods that will incumber his plant with unjustified construction charges in order to secure for himself the greatest benefits. His attention being concentrated upon making a record quickly may cause him to neglect proper analysis of construction expenditures, and repair the depreciation accounts. The load he will eventually pile up on the plant account would be left for his successors to worry about.

As it is with the chief executive, so it will be with his superintendents and their assistants, and all of the other employees under them. Incidentally, the selfishness of the management will be noticed by the employees and imitated by them. In some form or other they will also have their own personal graft; "like master, like man."

There are certain elements in the gas business that are purely local and peculiar to each individual plant. They probably constitute the largest and most important portion of the gas man's education, and the gas man who stays with his company should be compensated for this knowledge. It is the theory upon which we justify an advance in salary for length of service.

There are no two gas companies exactly alike. The man who knows the most about a company and its peculiarities and environment ought to be the man who has grown up with it. There is certain knowledge that is not a matter of record; it is very subtle and defies definition. It is the result of:

1. A good understanding of the political and social life of a city—a very valuable asset and one that cannot be absorbed in a short time.

2. The man's personality; I believe it is as valuable as all of his specific knowledge of the business put together, both in the internal management of the company and the influence on the public. By long association only, can the gas man acquire the confidence of his associates and the public. He will know all of the leading citizens of his town; not only in a business way, but socially also, and will be able to place the correct estimate on them when brought in contact with them. Such knowledge and confidence is cumulative; it is acquired slowly and cannot be accurately obtained except by long association and patient effort.

"Efficiency and permanence of labor" is susceptible to greater improvement than any other factor of our business, and is dependent largely on permanent management. When a manager remains with his company, his assistants are very apt to do so, and they in turn hold the other employees. The employees of a company form an almost endless chain, reaching practically every social and business circle in the city. If they are intelligent, of good moral repute and good address, the impression given the public will be good. If they are not, and changes are frequently made, the impression will not only be bad, but the company will be subject to slander by those who leave. An employee rarely leaves a company without carrying with him more or less ill feeling toward it, and there is no telling how much lying he will do to cover up the real reason for his departure, or as a matter of spite, to get even.

It is a very disagreeable fact that the statements of disgruntled employees are usually regarded as more truthful than the contradictory ones made by the officers of the company. The statement of a discharged bookkeeper might require the combined efforts of the general manager and board of directors to refute it, and possibly an examination of the company's books by a set of experts. Even then there will be a few skeptics ready to discredit the experts' statements, believing that they were bought by the company. This is one reason for retaining a permanent organization. Another good one is that changes always bring about more or less internal as well as political disorder.

A gas man leaving a plant nearly always takes one or more of its employees with him to his new field. The new man naturally starts a small panic of resentment among the old employees, some of whom naturally expected promotions.

Of course there is a lot to say in favor of the "outsider." If a vacancy occurs or a place is to be filled, and no one on hand big enough to fill it, there is nothing to do but bring in an "outsider." To be sure, it is preferable to promote a man from the ranks, provided an exceptional man is available, but when such a one is not and a good man is needed, the "outsider" is inevitable. An occasional "outsider" is

*Paper read before the Michigan Gas Association, Sept. 19, 1906.

good for a company, and good for the employees, too; it prevents stagnation.

I have digressed somewhat from the subject in considering "why it is best for a company to retain an employee," and I offer as an excuse, that the employee cannot be considered without the company. Whatever benefits the company will (or it should) also benefit the employee. If the employee believes he is not receiving fair treatment, he should get out and go where he can. Then, too, the company should get rid of the "peace disturber"; pruning is as necessary to organization to keep it healthy, as it is to trees. One disgruntled grumbler will often infect the whole organization with the "fever of discontent." The gas man must be loyal to the company that pays him a salary. Then, and only then, can he hope to share its prosperity.

Briefly: If he remains with his company, is loyal to it and works for its owners as he would if owned by himself, his greatest satisfaction will be the knowledge that his methods have succeeded and that he has acquired the admiration and esteem of his chief executive, as well as of the other employees and the consumers. If the company is successful through his efforts he will participate in its success; his compensation will be well taken care of; trust the president and board of directors for that.

HISTORY OF THE CO-OPERATIVE ELECTRICAL DEVELOPMENT ASSOCIATION.

A few years ago the interest in electric power stations lay mainly in their development from a purely engineering point of view, but it is only necessary to glance at the technical journals of the present day to recognize the consideration and thought which are now given to the business-getting departments of central stations, and to the commercial introduction of electrical appliances.

One of the greatest factors in bringing about this change is the aggressive activity of the Co-operative Electrical Development Association, which, though still in its infancy, has accomplished a great deal toward promoting the interests of the electrical business. The history of this association was brought out at the joint meeting of the electrical trades, held in New York on December 13th, to discuss ways and means of organizing this co-operative association on a permanent basis.

The idea of co-operative action affecting an electrical industry originated with the Incandescent Lamp Manufacturers in February, 1905, their purpose being to secure the co-operation of the distributing trade to encourage the use of incandescent lamps. An appropriation of $10,000 was then made to put the initial plans into effect.

Further consideration of the subject led to the logical conclusion that it would be a mistake to confine the activity of such a movement to the lighting end of the business since a high all-day efficiency of power plants depended on the sale of electric power for heating and motive purposes.

It was also recognized that the distributing trade would be more actively interested in a movement which had for its object the promotion of the electrical business as a whole rather than of a particular class of products exploited by a limited number of manufacturers.

A paper was read before the National Electric Light Association at Denver in June, 1905, advocating this broader scheme of co-operation, and the Association appointed a committee of three central station managers to co-operate in the development of the work.

This broader proposition was taken up by the Incandescent Lamp Manufacturers on February 7, 1906, and was unanimously endorsed. It was decided to make an appropriation of one-fifth of one per cent of the aggregate sales of the various members for a period of three years, to be used in furthering this movement.

On March 23rd following, a joint meeting of the electrical trades was held in New York to consider the matter. A resolution was passed expressing confidence in the practicability of the movement and in its promise of producing highly profitable returns. A committee was appointed to formulate a practical scheme of organization and, when a sufficient number of business concerns had agreed to co-operate in the work, this committee was to be authorized to take such steps as were necessary to make the organization an effective one.

The members of the National Electric Light Association, at the convention held in Atlantic City in June, 1906, evidenced the keenest interest in this proposition, which received the unqualified endorsement of the Co-operating Committee appointed at the Denver meeting. President Williams of the Association appointed a committee of five central station managers to work together in behalf of this movement. At the joint meeting of the electrical trades held on December 13th, committees were appointed to report on such matters as are preliminary to effecting a final organization, which, it is hoped, will be possible at the next meeting.

From May, 1905, to November 30, 1906, the Association expended $28,256.41, principally in the issuing and circulation of advertising matter. The Association estimates that the publicity obtained through the hearty co-operation of the technical press and newspapers, was equivalent to an additional expenditure of $60,000. The results so far attained are very gratifying, assuring the practicability of a movement which promises large returns in the future.

DIRECTOR OF WORKS APPOINTED FOR THE ALASKA-YUKON-PACIFIC EXPOSITION AT SEATTLE.

Frank P. Allen, Jr., an architect and engineer of wide experience, has been appointed director of works of the Alaska-Yukon-Pacific Exposition which will be held at Seattle during the summer of 1909. It is his duty to supervise all work done on the grounds, and after the Exposition opens to have charge of the maintenance of the grounds and buildings.

Mr. Allen gained his exposition experience at the Lewis and Clark Exposition at Portland in 1905, where he had charge of the structural work. Mr. Allen was born in Grand Rapids, Michigan. He secured his early training in his profession under his father, Frank P. Allen, Sr., who was a prominent architect. After taking a course in civil engineering at the University of Michigan he went to Chicago where he spent six years, specializing on structural work for bridges, railroads and large buildings. At Portland he became a member of the firm of Lewis & Allen, consulting and construction architects and engineers. He is manager of the General Engineering and Construction Company, of Seattle and Portland.

The Exposition grounds cover 250 acres of the unused portion of the campus of the University of Washington, and border for more than a mile and a half on Lake Washington and Lake Union. The site has been pronounced by John C. Olmsted, the famous landscape artist, who laid out the grounds, as the most beautiful ever utilized for such a purpose. Mt. Rainier and Mt. Baker, with their perpetual snow peaks, are in plain view. Twelve large exhibit palaces will form the nucleus of the Exposition. Work on the grounds has already begun under the direction of Mr. Allen.

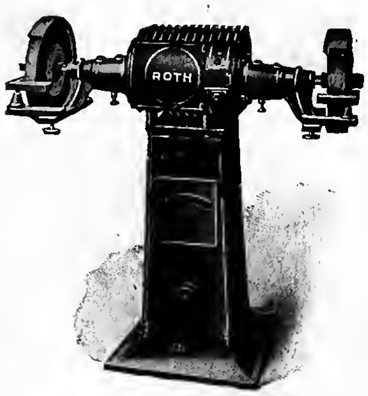
It is estimated that Cape Colony required in 1905 an average of 281,100 electrical horsepower, and it is, therefore, no wonder that British capitalists are as anxious to harness the natural energy of the Victoria Falls as Americans are to completely utilize the waters of Niagara.

INDUSTRIAL

IMPROVED MOTOR-DRIVEN POLISHERS AND GRINDERS.

The illustration shows the larger sizes of grinders manufactured by Roth Bros. & Co., Chicago.

One of their distinctive features is the short distance between the front of the motor casing and the shaft. This permits long pieces to be worked with the utmost ease. With the ordinary construction, where the shaft projects from the center of the casing, it is necessary to work on the corners of the wheels because the work strikes. Not only is the amount of work which can be done considerably less, but the life of the wheel is shortened. The removal of this fault marks a great step in advance.



Another distinctive feature is the ribs with which the motor casing is covered. The surface available for radiation of heat is increased about three times. The amount of hard work and overload which the motor will stand is increased the same amount and, besides, cool running is assured under normal conditions.

The pedestal base contains the switch, starter and field regulator. The speed can be adjusted to suit the decreasing diameter of wheel as it wears down. When the regulator is adjusted to a certain speed that speed is maintained almost constant, no matter how hard the grinding.

Some other good points are: Bearings adjustable for end play; crucible steel shafts; removable shafts; heavy bases preventing vibration; really dust-proof covers, etc.

These distinctive features go to make up a grinder which has proven to be unexcelled.

A MODERN PLATE GLASS PLANT.

The Crystal City Plant of the Pittsburg Plate Glass Company is now about completed at Crystal City, Mo., 28 miles below St. Louis. There are 15 buildings, all of reinforced concrete. It is estimated that 50,000 barrels of cement will be used in the building process, the brand being the "Universal Portland," made in the cement division of the U. S. Steel Corporation. Even the roofs are to be reinforced concrete tile, 4 feet by 8 feet.

In the equipment of this huge plant, due provision has been made for adopting the most modern methods of manufacture. Among industrial plants of its kind, this establishment is unique as being one of the largest in the country, and also as being remarkable because of the unusual size of the power and lighting units installed there. The machinery will be driven by electric motors of exceptional size. The power equipment already contracted for includes an 1,800-B. horsepower gas engine, direct connected to a 1,000-kilowatt generator.

This unit will be installed in the same power house with a 5,000-horsepower Allis-Chalmers engine, famous as the "Big Reliable." This engine carried the entire lighting load for the illuminating of buildings and grounds of the Louisiana Purchase Exposition at St. Louis. The name was given it by the attendants because of continued good service during the entire duration of the Fair.

Sixteen hundred horsepower in Allis-Chalmers induction motors will be used to drive grinders and polishers.

The Tracy Engineering Co. has just received nearly a carload of foundation bolts for a large number of Nordberg-Corliss engines and compressors recently sold to the Selby Smelting Company for their San Bruno plant.

COMPLETE ELECTRICAL EQUIPMENT FOR A SAWMILL.

The Great Southern Lumber Company has decided to install a complete electrical equipment in its new mills at Bogalusa, Louisiana. The company controls various properties in different lumber centers, and the new mill will be not only the largest in the United States, but also will have the most complete electrical equipment. As a result of this latest industrial center a new town is being built within the confines of the old, which before had not even a postoffice.

The electrical equipment will be furnished by the General Electric Company, individual induction motor drives being used on all of the machines, the total motor equipment aggregating some 2,400 horsepower. The induction motor has been found particularly serviceable for this class of work, and being so simple that it is often compared to a piece of shafting revolving between two hangers, little attention is required. Having neither commutator nor brushes, there is no sparking, therefore this type of motor will operate without fire risk, in the dust or shavings, incidental to sawmill work.

At the new mill, the generating equipment will comprise three generating units, direct connected to steam engines. Two of these units have 500-kilowatt (about 750 horsepower) electrical generators, while the third unit will be smaller capacity, generating about 300 electrical horsepower. All three units will be of the General Electric, three-phase, revolving field type, running at 100 revolutions per minute and generating current at a potential of 2,300 volts, and a frequency of 60 cycles. The power house will also contain two direct-connected marine generating units, each consisting of a 30-kilowatt generator, driving at 305 revolutions per minute by a direct-connected vertical engine. These machines will supply direct current at 125 volts for exciting the fields of the generators. A complete switchboard will also form a part of the power plant equipment.

From the power house the current will be transmitted to small transformer stations outside of each building; here the voltage will be "stepped down" from 2,300 volts to 440 volts for operating the motors at the individual machines. This use of alternating current for operating the motors permits considerable saving in the transmission system. The motor connections to the transformer stations will be made by means of cables insulated with varnished cambric and laid in unlined steel conduit.

H. W. Johns-Manville Co. have sent out an attractive little circular giving a "practical demonstration" which shows why the J. M. Giant Strain Insulator has proven so successful. Suitable for circuit up to 5,000 volts.

A ONE HUNDRED AND FIFTY THOUSAND-VOLT TRANSMISSION LINE.

To American engineers, especially in California, where the transmission of electrical energy has reached a high state of development, the project of the British South Africa Company to build a transmission line 600 miles long, will seem utterly impracticable in the light of the many difficulties to be overcome. This company proposes to generate electric power at the Victoria Falls in Rhodesia, and transmit it to the Witwatersrand, which has long been known as one of the richest gold-mining districts in the world.

The Victoria Falls is a gigantic cataract on the Zambesi River, about 600 miles northwest of Johannesburg. As a scenic spectacle these falls rival the Niagara Falls in their beauty and majesty, and are very popular with tourists traveling in Africa. The Zambesi River, just below its confluence with the Kuanda, is divided by three small islands into four streams which suddenly plunge over a vertical precipice into a chasm from 100 to 300 feet across. The two easterly falls are almost dry in summer, but the main fall, which is centrally situated, is 300 feet wide and 400 feet high.

According to the present plans the water turbine station will be built at the bottom of the gorge, just beyond a sharp bend, so as not to interfere with the natural scenery of the falls. It is proposed to generate initially 50,000 horsepower, and to operate the plant at its maximum capacity irrespective of the magnitude of the load.

A pumping station is to be built on the Crocodile River about 500 miles from the falls and 100 miles from Johannesburg. There will be installed motor-driven pumps which, during periods of light loads, will be operated by the surplus power from the turbine station to store water in a large reservoir to be built on the adjacent hills. During periods of maximum demand auxiliary dynamos will be operated by this supply of stored-up energy to regenerate electric power.

Without such a scheme of alternate storage and regeneration much of the kinetic energy of the swiftly moving water at the falls would be wasted when the power demand is light, as it commonly is in hydraulic plants in California. This arrangement also permits the plant to be operated continuously at full load, which results in a high efficiency with a corresponding increase in the earning power of the investment.

To guard against interruptions of the system by shutdowns or other contingencies, an auxiliary steam plant will be built about 100 miles from Johannesburg, to have a capacity of 20,000 horsepower.

To economically transmit electric power for a distance of 600 miles in accordance with current practice, requires that the line voltage shall be greatly increased over that now employed. In spite of the fact that a line pressure of 60,000 volts is generally considered at the present time as the maximum voltage which can be employed with an assurance of safety and reliability, the engineering experts of the company seem to have great faith in their ability to solve the difficult problems involved in the construction of a 150,000-volt transmission line. Their plans for insulating the conductors on the cross-arms and securing good voltage regulation besides controlling the excessive charging current produced by the capacity of a 600-mile line, have not been made public. It has, however, been decided to use aluminum cables for the conductors. These will be carried on steel towers sixty feet high.

The Platt Iron Works, through its San Francisco manager, Mr. E. Dewald, has closed a contract with the Exchequer Gold Mining Company for a 600-horsepower water wheel to drive the generators and air compressors on the latter company's property. Messrs. Hunt, Dillman, Meredith and Allen were the consulting engineers.

News Notes

ELECTRIC RAILWAYS.

Cheney, Wash.—Eslick & Carpenter, contractors on the Spokane Interurban, have opened headquarters at this place.

Eugene, Ore.—The Willamette Valley Company took out a water right which will use 80,000 miners' inches, and it is their purpose to use the power thus developed in carrying on an electric line from Eugene to Blue River.

Lewiston, Ida.—Two surveying crews were sent out on the proposed route of the Lewiston & Southeastern electric road between this city and Grangeville.

Helena, Mont.—The Helena Light & Railway Co. will change and improve its car tracks.

North Yakima, Wash.—Representing Frederick Elmendorf, of Spokane, T. A. Noble filed an application with the county commissioners for an electric railway franchise to the Mexee Valley, and then southwesterly through Union Gap to a point below the intake of the Sunnyside canal.

Spokane, Wash.—Sealed bids will be received at the office of the Oconagon Electric Ry. Co., 408 Empire Bldg., until Feb. 6, for furnishing 60,000 railroad ties.

Seattle, Wash.—Mayor Moore signed the ordinance granting to M. J. Wightman and C. E. Muckler a franchise for a right of way through the city.

South Bend, Wash.—A franchise has been granted by county commissioners to M. C. Welsh for the building of an electric railway between South Bend and Raymond.

Seattle, Wash.—The Seattle Electric Company is making rapid progress on the line to and through West Seattle. From Youngstown the track has been laid for two miles.

Turlock.—Mr. Irwin reports that if the weather permits, the grading on the Irwin City and Southwestern electric line will commence at once. The rights of way have all been secured and all papers signed up except with two parties, and soon these will have been signed. Mr. Irwin states that he expects to be able to have cars running into Irwin City in sixty days after starting on the grade at this end of the line.

Chico.—The Northern Electric Company has enroute from the factories in the East the greater part of a consignment of 200 flat cars which will be added to its rolling stock on its lines between Chico, Oroville and Marysville and other lines soon to be constructed. Some time ago an order was sent to different factories and car shops in the East for 200 flats and ten or fifteen of these have already been received here. The rest of the order is now on the way in small numbers. The cars are of 80,000 pounds capacity each and of the regular build and pattern.

Los Angeles.—It is stated that the Los Angeles Pacific Railway Company has closed deals for the purchase of Nob Hill, the miniature mountain at Playa del Rey, and proposes to tearing it down and use the earth for filling in the low swampy ground in the vicinity. The company proposes to expend many thousand dollars in improvements there in the near future.

Fairfield.—The Supervisors have extended the Hartzell electric road franchises on a number of roads in the county for six months. Grading has just begun on the proposed road from Benicia to Vallejo.

San Diego.—H. E. Huntington of Los Angeles has applied for a railroad franchise which is intended to be one of the links in a railway line soon to be constructed between Los Angeles and San Diego.

Los Angeles.—Sealed bids will be received by the city clerk for a franchise for an electric railroad upon certain streets in Los Angeles. The Railroad will begin at the intersection of W. First with Hill street, along Hill, passing through the tunnel to be built by the city between W. First and Temple streets to the northerly line of Temple.

TELEPHONES AND TELEGRAPH.

Blackfoot, Mont.—The R. M. Telephone Co. has moved its offices into their new building.

Grangeville, Ida.—C. McDaniels, manager of the Buffalo Hump Tel. Co., is building a telephone line from Concord to Oro Grand.

Helix, Ore.—The Farmers' Tel. line has decided to connect with the Pacific States line.

Nampa, Ida.—Messrs. Beveridge and Leonard, of the Western Electric Co. of Chicago, are here to install the switchboard at the local telephone exchange.

It is stated that the Sunset Telephone Company contemplates stringing six wires from San Francisco to Manhattan, Goldfield and Tonopah. These wires will pass through Reno and Sacramento and will greatly increase the efficiency of the telephone service between these cities. It is estimated that the cost of stringing these wires will be more than $500,000.

Spokane, Wash.—M. A. Phelps, president of the Interstate Telephone Company, announces that the lines will be extended into the Coeur d'Alene mining district in Northern Idaho, the total cost of the improvement to amount to $125,000. It is purposed to reach all the towns in the mining district and other points in Idaho, making 450 miles, work beginning early next spring. The company has just taken out a mortgage for $500,000 in favor of the Spokane & Eastern Trust Company, for 20 years at 6 per cent. The plant at Sandpoint has been enlarged, the improvements consisting of a double switchboard and a number of cables, also a second copper circuit from Sandpoint to Laclede, 16 miles, and a second circuit from Rathdrum to Athol.

ILLUMINATION.

Selma.—The Selma Light and Water Company is to pass into the hands of the San Joaquin Light and Power Company, and an entirely new system will be laid to all parts of the town, and the service made as complete as possible.

Pasadena, Cal.—A contract for the concrete foundation work for the building to house the new electric lighting plant has been awarded to Ellsworth & Co., of this city for $1370. The contract for item No. 2 in the notice for bids, being for a steam pumping head and draw valve pump cylinder, was not awarded, although bids were received. These bids were referred to Manager Glass for further investigation and report. Bids were received from Baker & Hamilton and the S. J. Smith Machinery Company.

The Palms.—Work is to be commenced within ten days on the installation of the electric lighting plant for the Palms.

Needles, Cal.—Ground was broken this week for the construction of the electric power and light plant of the Victor Gold Mining Company.

San Jacinto.—Work on the Hemet-San Jacinto Gas Company's plant is to begin the first of the week and the plant is to be in operation some time in May.

Chico, Cal.—The officials of the Chico Gas & Electric Light Company have perfected plans for a complete change and overhauling of its power and lighting plant in this city. One of the changes to be made is the removal of the substation from its present site at the Gas Works at the corner of Second and Cherry streets to the concrete sub-station immediately south of the Northern Electric Carbarns. A pole line will be run from Park Avenue from the new sub-station up Main street.

Bisbee, Ariz.—The Bisbee Improvement Company is taking steps to remodel its electric light plant. Louis R. Fosdick, an expert electrical engineer from New York, is on the ground and will prepare plans and specifications for an up-to-date plant.

INCORPORATIONS.

San Francisco.—Articles of incorporation have been filed for the City Electric Company, which has been formed for general lighting and power purposes. The capital stock is $5,000,000, of which $9000 has been subscribed. The directors are Adolph Mack, J. J. Mack, Henry Steinbach, Mortimer Fleishhacker, Herbert Fleishhacker, W. S. Goodfellow, Charles P. Eells, Frank W. Smith and Walter Arnstein. Mortimer Fleishhacker and other directors of the new company deny that the concern has anything whatever to do with the San Francisco Coke & Gas Company merger, and they declare that the company is entirely independent of any other organization. The machinery for the new plant has been ordered and the promoters say that work on the plant, the site for which will be at some location not yet chosen on the bay shore, will probably begin next week. It is the intention of the company to manufacture all its electricity in San Francisco by the use of oil fuel. Turbine engines, the first to be introduced in San Francisco, will be used for the generation of the electrical current. The company will manufacture electricity for general lighting purposes, and its directors expect to reduce the present cost of the commodity. The plant will have a capacity of 10,000 horsepower.

FINANCIAL.

San Francisco.—Henry Brunner of the Central Trust Company, who has just returned from Paris, where he organized the French-American Bank, says: "A prominent French engineer, who is an expert in railroad and electric power matters, came to the United States with me and is now examining several propositions under my instructions. The financing is to be carried out by a group of French bankers, headed by the French-American Bank, in which a great many French bankers are interested as shareholders and several as directors."

San Francisco.—At the annual meeting of the Spring Valley Water Company, out of 280,000 shares over 167,000 shares were represented by owners or by proxy. The following board of directors was chosen: A. N. Payson, J. M. Quay, Homer L. King, I. W. Hellman, Jr., F. B. Anderson, J. Henry Meyer and M. B. Kellogg. The income of the company now reaches $130,000 a month, an amount sufficient for all claims, operating expenses, taxes and fixed charges of whatever character.

TRANSMISSION.

Red Bluff.—E. W. Sutcliff, who has charge of the construction of the voltage power line, is here to put 150 men to work on the new plant on Battle Creek, which, when completed, will cost $1,500,000. A dam just below the junction of North and South Battle creeks will be built which will be 130 feet high and 800 feet across. The water from the three creeks mentioned will be carried six miles in ditches to a power site on a section of land which this company has purchased from the Central Pacific Railway.

Auburn.—J. E. Russell has taken up the proposition of damming the American river near this city to secure a fall of 200 feet. The watershed embraces 1500 square miles with about 30 small lakes which are dry. The average rainfall varies from 36 at Auburn to over 100 inches at the summit of the Sierras. Mr. Russell declares that the best water power in the State lies unused at this point. The water is fine and soft and could well be supplied to Sacramento and San Francisco for domestic use. At the same time there could be developed from 10,000 to 30,000 horsepower of electrical energy.

Washington.—When the Army bill came up in the House of Representatives, Kahn made a successful plea for the insertion of $30,000 for the repair of the power station at the Presidio.

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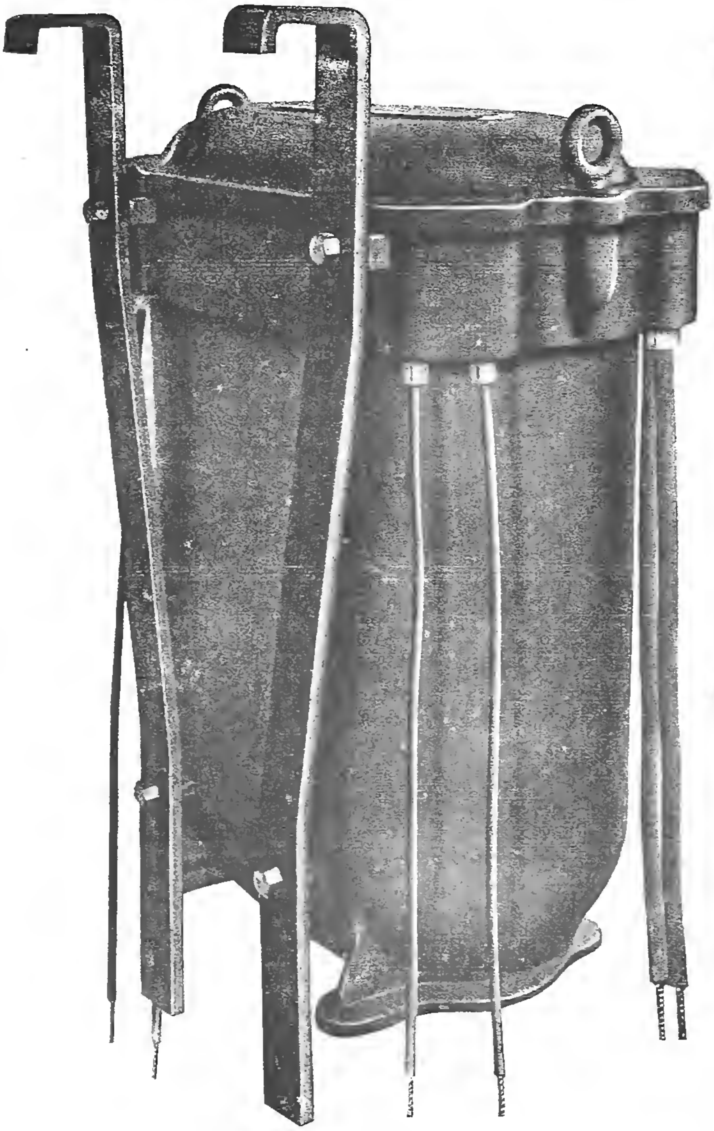

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For the convenience of the purchaser in comparing the data of other transformers, the characteristics below are compiled on a basis of 100 or 200 volts secondary, and 1000 or 2000 volts primary, although they may be operated at voltages 20 per cent higher than given above. The core losses, however, being slightly increased and the copper loss decreased by so doing.

It should be remembered that the value of the core losses of any transformer depend on the wave form of voltage, the above data being based upon a true sine curve. A bunch-wound armature will deliver a pointed wave form of voltage, in which the core losses will be reduced. Whereas, a machine delivering a flat-topped wave form of voltage, the core losses will be increased.

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And Supplies in Stock
Prices Right
Delivery Prompt.

Prices Guaranteed
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. All sizes in stock.

Core Loss at 60 Cycles	Per Cent. Core Loss	Copper Loss	Per Cent Regulation	EFFICIENCY PER CENT				Capacity in Watts
				Full Load	3/4 Load	1/2 Load	1/4 Load	
22	4.4	16	2.74	93.	93.1	92.7	87.1	500
26	3.33	22	2.72	94.	94.1	92.9	88.2	750
30	3.00	27	2.70	94.6	94.50	93.19	89.86	1000
37	2.42	34	2.46	95.4	95.41	94.28	90.50	1500
44	2.20	46	2.43	95.70	95.79	94.57	91.00	2000
48	1.92	55	2.37	96.00	96.12	95.41	92.53	2500
49	1.63	60	2.30	96.40	96.54	95.93	93.50	3000
55	1.37	82	2.27	96.67	96.82	96.31	94.40	4000
61	1.22	100	2.15	96.83	97.12	96.70	95.00	5000
87	1.16	145	1.98	97.00	97.32	97.02	95.40	7500
105	1.05	177	1.83	97.25	97.48	97.21	95.52	10000
122	.98	202	1.76	97.40	97.70	97.39	95.95	12500
134	.90	252	1.64	97.50	97.74	97.42	96.11	15000
163	.80	320	1.55	97.64	97.89	97.79	96.46	20000
187	.75	380	1.48	97.78	98.03	97.88	96.76	25000
204	.68	432	1.42	97.92	98.12	97.96	97.01	30000
244	.60	556	1.40	98.04	98.28	98.12	97.29	40000
271	.54	640	1.30	98.21	98.44	98.30	97.57	50000

STANDARD ELECTRICAL WORKS

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THE

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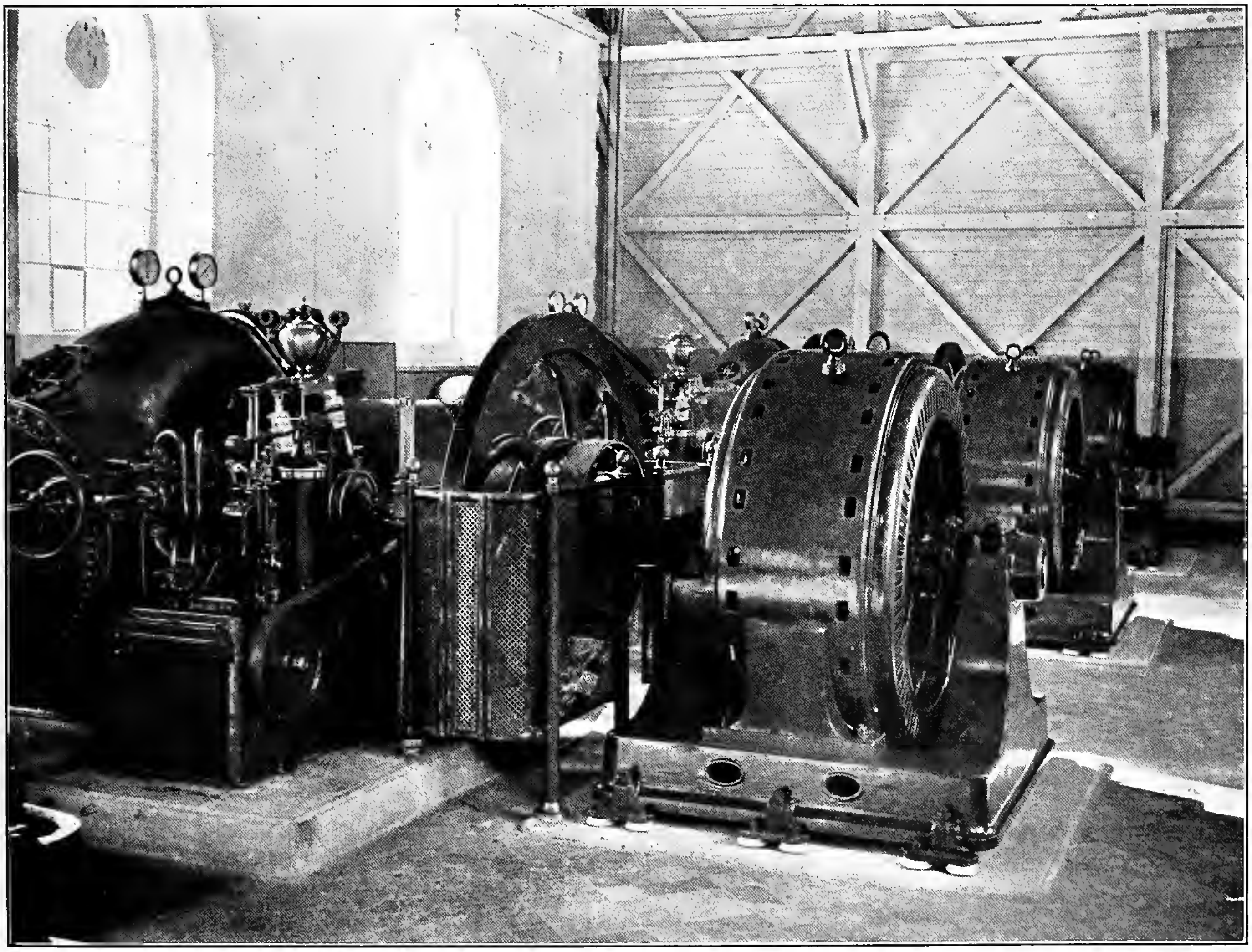
Hydraulic Turbines of Swiss Manufacture.

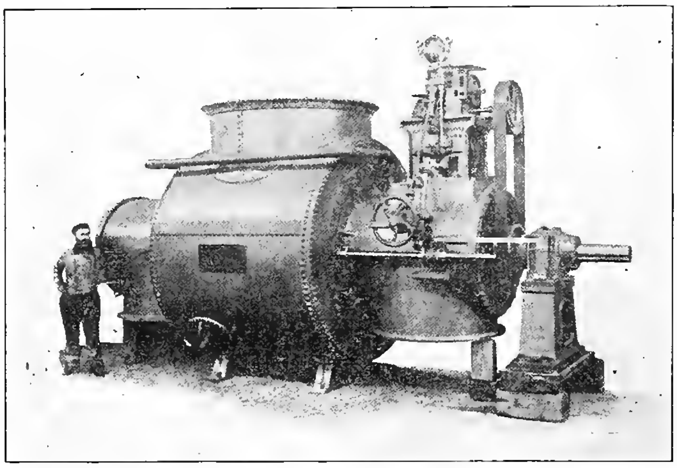
Although French engineers have made some progress in the design of hydraulic turbines, the Swiss have surpassed them in producing machinery of this type of a very high efficiency. As a result the products of their design and manufacture are found in power plants and pumping stations all over the world.



FIER HYDRO-ELECTRIC PLANT HAUTE SAVOIE, FRANCE.

At the Usine de Sant-Mortier, near Jura, France, nearly 3,000 horsepower are developed by four Swiss turbines, each having a capacity of from 700 to 750 horsepower. These operate under a head of 65 feet at 250 revolutions per minute, driving the alternators through elastic insulating couplings of the Rafford system. A feature of the exciters is that they are mounted on the same shafts as the alternators, but outside of the main bearings. In addition to the four units already described, a turbine of the same type but capable of developing 1,250 horsepower is also installed at this plant. Its speed is 214 revolutions per minute.

The station is located near the junction of the Ain and Bienne Rivers which of themselves carry an insufficient quantity of water to generate the required horsepower. It was therefore necessary to construct a canal from Lake Chalain,



SWISS TURBINE AT SAUT-MORTIER HYDRO-ELECTRIC PLANT IN FRANCE.

some distance away. By this means the quantity of water available was increased by 565 cubic feet per second.

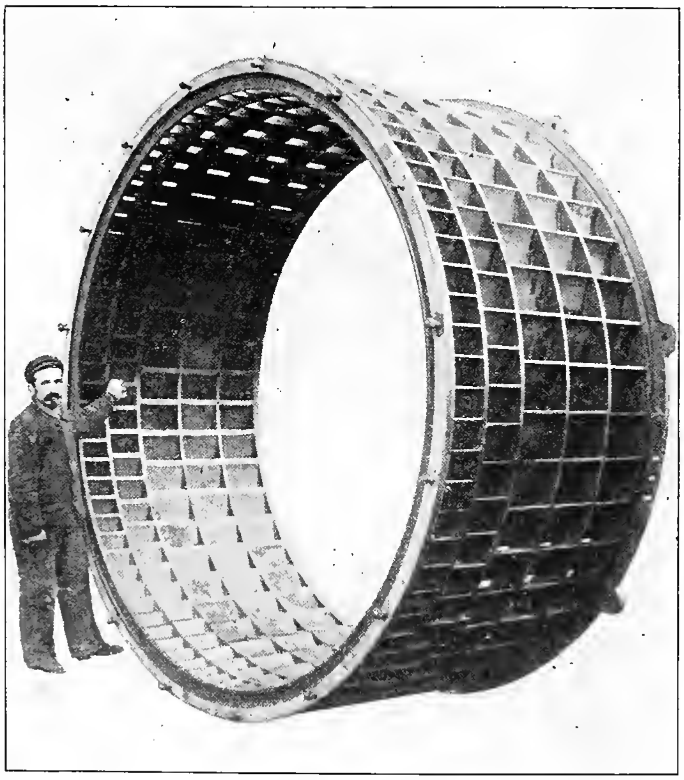
The turbines at the Jura plant are all of the horizontal type. A vertical shaft turbine has been installed in a hydro-electric plant at Meurthe et Moselle to operate under a very low head of from 4.9 to 6.2 feet. Its speed is only 32 revolutions per minute and its total capacity is 165 horsepower with a discharge of from 210 to 350 cubic feet per second.

The water wheel is 9.2 feet in diameter, and on its periphery are arranged five rings of buckets. A bevel gear-wheel of about the same diameter as the water wheel is fastened to the vertical shaft and drives a pinion mounted on a horizontal shaft, which supports a fly-wheel more than 13 feet in diameter and rests in three large bearings. The water is conducted to the wheel through a concrete chamber and is led onto the buckets by guides built at the sides.

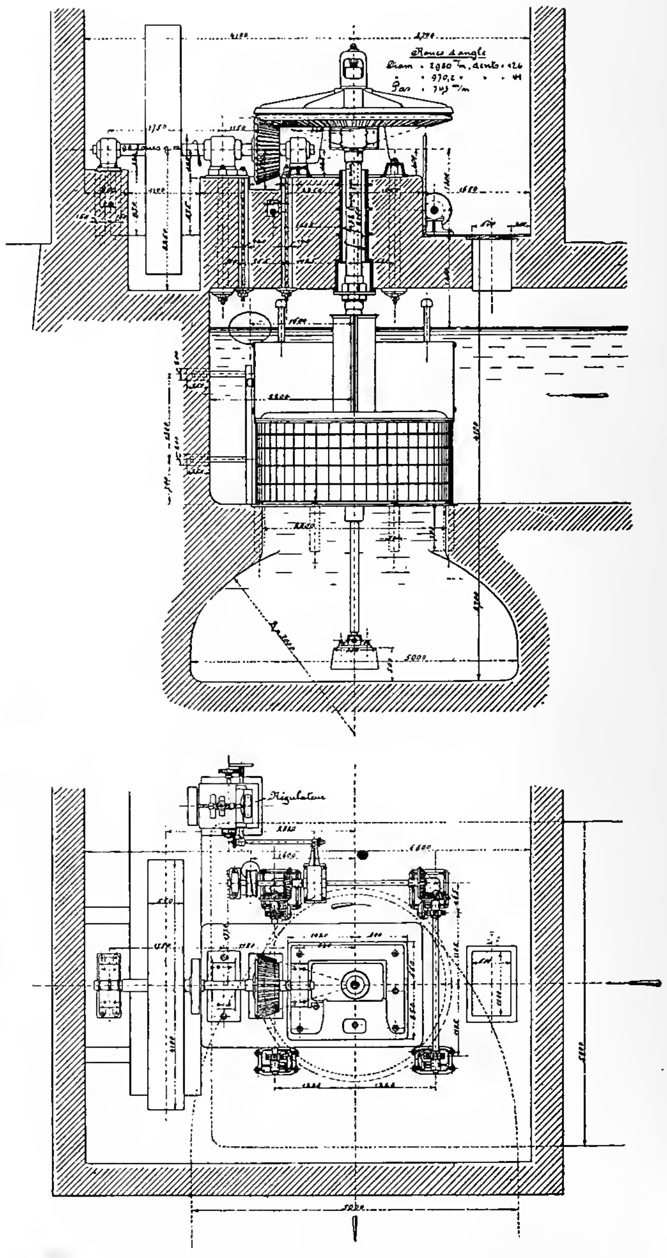
At Montiers, Savoie, also in France, four Swiss turbines are employed for generating electrical energy to be transmitted to the City of Lyons. Each of these is capable of developing 1,570 horsepower under a head of 213 feet, and drives an alternator by direct connection at a speed of 300 revolutions per minute.

Turbines of a similar type to the above but of much smaller capacity, are employed in the Usine Hydro-Electrique de Verein, in Spain. These have a normal output of 120 horsepower and operate at a speed of 600 revolutions per minute.

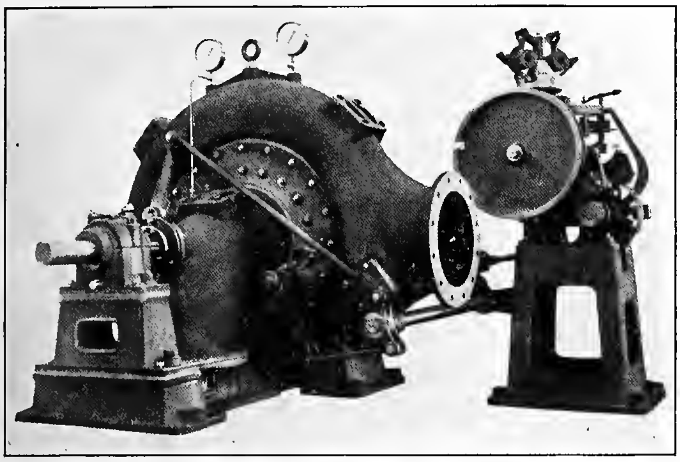
The regulation is accomplished by a ball governor, and the power required to operate the gate valve is taken from the main turbine shaft through a belt transmission. At normal load working under a head of 146 feet, each turbine takes about 9.5 cubic feet of water per second, which enters at the side and is discharged at the end.



STATOR AND GUIDES OF LOW-PRESSURE, LOW-SPEED SWISS TURBINE.



LOW-SPEED, LOW-PRESSURE TURBINE.



SWISS TURBINE AT THE VERIN HYDRO-ELECTRIC PLANT IN SPAIN.

At the Installation Hydro-Electrique du Fier, there are in operation three hydraulic turbo-generator sets, each of which consists of a turbine and alternator connected by a flexible coupling, with a fly-wheel mounted between them. The normal speed is 430 revolutions per minute and the capacity of each turbine is 375 horsepower for a head of 60.5 feet. The exciting current for the alternator fields is supplied by a four-pole dynamo driven at a speed of 800 revolutions per minute by direct connection to a 20-horsepower water turbine. Servo-motors are employed as regulators, and give excellent results.

TRAIN MOVEMENT.

By Elbert G. Allen.*

Choice of Motors.—The general type and size of motor to be used in a given service is a fairly well-settled fact. It is, of course, necessary for economic reasons to use some standard motor of a reputable manufacture. The various manufacturers have well-developed types of motors suitable for use under the various conditions of service. Knowing, then, the approximate conditions under which the equipment will operate, such as weight, schedule, speed, grades, and number of stops, it is easy to narrow down the choice of equipment between two or three sizes by comparison with the satisfactory performance of other roads and the general statements of the manufacturers. The definite and careful selection between these two or three motors is a matter for considerable skill in the analysis of the requirements of the case. For interurban roads, the performance of the motors can be very accurately foretold. The conditions of stops and schedule speeds are matters for pre-determination. The schedule speeds are to a certain extent dependent on the final selection of the equipment itself, but in general the selection of the latter is subject to the requirements of the former. Knowing the conditions it is only a matter of calculation to lay out speed-time and speed-distance curves for the entire run for any equipment by the use of motor characteristic curves furnished by manufacturers. From the curves can be determined the proper gear ratio for each equipment and those which cannot make the necessary schedule can be eliminated from consideration. The question then remains whether the equipment selected will give the service without overheating. With the speed-time curves worked out, the manufacturers stand ready to guarantee apparatus to give the proper performance without overheating.

It is frequently permissible to omit the working out of speed-time curves for the entire run but to select some typical parts which are repeated several times during the run and base calculations on these. With an interurban road running through a level country where stops are about equidistant, a single run may frequently be selected which is typical of the entire run, and is merely repeated between each stop. At other times it becomes necessary to select several typical runs—for example, one on a level, one on an average grade, etc.

For convenience in comparison it is customary to rate a railway motor by the horsepower output which it can maintain for an hour with a maximum rise in temperature of seventy-five degrees Centigrade when tested in the shop. Such a rating gives little information regarding the amount of output which the motor could safely maintain under service conditions, and there is no connection between this rating and any information which can be obtained by analyzing the speed-time curves for a run. In order that one may determine the effect of any run on the temperature of the motor it is necessary to have either definite experimental knowledge of the heating of the motor under a variety of operating conditions similar to the required conditions, or a knowledge of the characteristics of the motor, such as the copper and iron losses for all conditions of voltage and output.

By means of exhaustive tests in which a motor is put through a certain definite cycle of operations repeatedly until its temperature becomes steady, it is possible to tabulate for any motor the temperature rise which it will sustain if required to propel any given weight at a given schedule speed making a given number of stops per mile. If this data is available it is only necessary to reduce any given operation to a repetition of typical runs and by reference to the tables, to find the temperature rise which the motor sustains if repeatedly put through this cycle of operation. This method of judging of a motor's fitness for the work to be imposed upon it has the advantage that it is based on actual tests made under service conditions. It is a method, however, which may be employed only after very exhaustive tests, and is difficult of application where no very typical run can be selected. Moreover, it gives no good means for direct comparison of different equipments and leaves a purchaser to rely almost solely on the advice and guarantee of the manufacturer.

The electrical losses in a motor consist of the copper and iron losses. The copper losses are proportional to the square of the current input. The iron losses are variable with the impressed voltage and to a certain extent with the current. It would appear that if a motor were passed through any cycle of operation the heating could be fairly well reproduced by subjecting the motor to a stand test with the same average voltage at the terminals and the square root of mean square value of current input. This being true, a very simple method of comparing the service capacity of motors consists in subjecting them to stand tests under these conditions and observing the rise in temperature. If, during the run, a motor is to be subjected to an excessive rate of input for a short time, as, for example, in climbing a steep hill, the rise in temperature during this time might exceed the average rise. It is consequently necessary to know also the length of time necessary for a motor to reach a dangerous temperature at any rate of input above the normal rate. By stand tests the safe square root of mean square current for continuous running may be determined and also the safe length of time for which higher rates of input may be maintained. With this data it is easy to compare different motors and to determine if a motor is suitable for the work in hand.

This method has been objected to on the score that the stand test does not reproduce exactly the conditions of ventilation and distribution of losses of the actual run.

*This is the second of the series of lectures by Mr. Allen before the Electrical Engineering students of The University of Washington.

For ordinary work either the manufacturers' data based on experimental runs or on stand tests with equivalent current is reliable and adequate. Final decision in any case depends upon the manufatcurers' guarantee.

For city and suburban service, it is, of course, impossible to work out speed-time curves covering the entire performance of the car. No two runs will be alike on account of the varying number and location of stops and variations caused by external conditions, such as blockades, etc. It is surprising, however, on comparing the runs over a given route, day in and day out, to see how nearly alike they all are as regards their general features of schedule speed, stops per mile, per cent. of drifting, etc. As a result of this it is almost always possible in such service to select a single cycle of acceleration, coasting, braking and stop which shall constitute a run typical of the entire day's performance. From such a typical run data may be obtained which will enable an equipment to be selected by the methods used in interurban work.

Four-motor vs. Two-motor Equipments.—The advisability of using four-motor equipments for all but very light traffic or in places where grades are light and weather conditions good, is generally conceded. The change from the use of two to four-motor equipments has been brought about by the increase in car weights, speed and the necessity for extremely rapid accelerations. On account of the high-schedule speeds desired with frequent stops, low-gear ratios and rapid accelerations have become a necessity and these demand a high tractive effort and a relatively large motor capacity. Four-motor equipments have become a necessity in order to gain the necessary motor capacity without the use of motors of excessive size, and in order to increase the maximum tractive effort by making all the weight available on driving wheels. The entire weight on drivers is desirable both to obtain the desired acceleration and hill-climbing ability under normal conditions, but still more to obtain the best possible results when the rails are in poor condition on account of sleet, snow, etc.

As a matter of efficiency the two-motor equipment, other conditons being equal, is the more efficient in accordance with the general rule that subdivision of units decreases the aggregate efficiency. There is, however, less heating with four motors of equal combined power as the radiating surface is increased in greater proportion than the losses. The actual power consumption in a four-motor equipment is increased only by the slightly increased loss in efficiency. The belief that a four-motor equipment demands more power is due to the fact that in nearly every case the four-motor equipment is called upon for more work by hauling heavier cars or by actually making better time.

The cost of maintenance of a four-motor equipment may be expected to be less than that with two motors on account of the decreased heating and the smaller current to be handled by the commutator. Other advantages are the ease in handling the smaller motors, their greater clearance when placed under a car, the decreased wear on gears, axle bearings, trucks and wheels due to the division of strain and decreased slippage.

Block Signals.—On account of the necessity of using single track and turn-outs for electric lines many forms of block signals have been devised in order that two cars may not attempt to use a single track section in opposite directions simultaneously. Such block signals may be either manually operated or automatic in their action. If automatic they may be operated by the passage of the trolley wheel on some circuit-closing device, by some form of rail contact, or by the electrical short circuiting of the two rails by the wheels and axles of the cars.

It is frequently desirable that signals shall permit of the entrance of more than one car on a block if passing in the same direction in order to permit of "double heading" on special occasions or to allow two different lines to use a common section of track. Such signals should be cleared only when as many cars have left the blocks as have entered it. In a perfect signal provision should be made for cases where cars enter opposite ends of a block simultaneously and the mechanism should be such that if a car enters a block in error—for example, if the signal be set against it at a time when it be impossible to stop the car before entering the block, the act of leaving the block to wait until it can rightfully enter should restore the signals to a proper indication and leave the car rightfully in the block properly protected. Cars should be able to leave a block from either end and leave the signals indicating properly.

For the use of steam roads, block signals have been developed to a high state of perfection wherein the signals are built in a position indicating safety or a clean block by an electric circuit involving both rails of the track. The wheels and axles of a train in the block shirt-circuiting these rails, shunt the current from the signal relay and cause the signal to fall by gravity to a position indicating danger.

In steam-road practice, the various blocks have been separated by insulated rail joins. This practice needs modification in applying it to electric roads on account of the necessity for a continuous rail circuit for the return-motor current. A very successful system has been developed by using alternating current for the signals. The insulated rail joints are bridged by inductive bonds which have low ohmic resistance allowing the power current to pass freely, but high resistance effectively separating the blocks so far as the alternating signal current is concerned.

INDUSTRIAL PROGRESS IN ITALY.

It is stated that not only the leading Italian shipyards but also the locomotive and rolling stock factories are full up with work. The general briskness in the industrial world is, however, most remarkable in the south of Italy. Outside the cities of Naples and Palermo new industrial quarters are developing. The Naples Provincial Parliament has decided to construct a hydro-electric plant on the Volturno, at a cost of £400,000, whilst at Ponte della Serra (close to Padua) the Eismon River is to be used to generate 20,000 horsepower for use in various industrial establishments. Apart from such typical private enterprises it is notable that the revenue of the State shows a large and steady increase, and that considerable sums are now available for disbursement in various industrial and social improvements. Special attention is being paid to the needs of Italian railways, and the Government is now seeking authority to issue new 3½ per cent bonds, repayable in forty years, for £24,400,000. As an issue of £12,000,000 has already been granted for railway purposes, this would give a total sum of £36,400,000 to be spent from 1907 to 1911 in improving Italian railway services.

VARIABLE SPEED TURBINE ENGINE.

A turbine has been patented in England which, by means of two sets of steam admission ports, into either of which steam may be admitted at will, it is claimed will give two different speeds of operation at the same efficiency. For the higher speed the steam is conducted from one set of ports through expanding nozzles to the rotor, where it encounters two sets of moving blades and one set of fixed blades, passing thence to the exhaust. For the lower speed, the steam takes the same path through the blades as before, and is then led from the second set of moving blades into a group of blades consisting of two fixed and two moving sets. This arrangement gives a speed about half that due to the other, the reason being doubtless that, the expansion being carried through a longer stage, the drop in pressure at each set of blades is but half what it was before, with consequent proportional speed factor.—"Iron Age."

THE TESTING OF COAL.

By A. Bement.

The purchase of coal under specification stipulating its composition, and the analysis of the fuel delivered under such specification, has now become an important feature of the coal business, and while the practice is of comparatively recent origin in this general locality, experience has demonstrated that there are certain features of specifications and analytical methods which may be corrected and improved. This applies particularly to the business transactions between the dealer who sells the coal and the purchaser who burns it. Another phase of the problem concerns the work being done at the coal-testing plants of the United States Geographical Survey at St. Louis, the Illinois Geological Survey and the Engineering Experiment Station, of the University of Illinois. The work of these institutions may be considered as that of research, to distinguish it from the inspection service.

It is the principal object of this paper to emphasize the necessity for improving the practice governing specifications and inspection, and also to suggest certain lines along which the research work should proceed, and it is fuel coal from the eastern interior coal basin that is more particularly considered.

The improvements and corrections which concern terms of specifications, and the inspection service, require that determinations of the following be abandoned:

Moisture,
Volatile matter,
Fixed carbon,
Sulphur,
Evaporative power of the coal.

Every essential requirement of the purchaser may be fulfilled by confining specifications and tests to the three following characteristics; in fact, these three features alone will insure greater protection to the purchaser than obtainable under present general practice:

Per cent. of ash in the dry coal,
Size of the coal,
Heating power of the pure coal.

The latter, according to prevailing practice, would preferably, of course, be expressed in British thermal units.

The reasons for the above recommendations are given under the following captions:

Moisture.

Moisture is a great and uncertain variable. It not only differs in various coal seams as the coal lies in the ground, but is affected in fuel as received in shipment, by conditions of weather, temperature and time the coal may be in transit. It is approximately correct, however, to say that each coal seam has a characteristic moisture content of its own, which is uniform over at least very considerabde areas, but the after influences above mentioned change it, so that there is no assurance of what it may be except under specially defined conditions.

Therefore, the producer or coal dealer can exercise no control over moisture, and as ihe prime object of fuel inspection service is to insure that the customer is served to the best ability of the dealer, specifications and tests of moisture in coal delivered can offer no protection to the purchaser. As before mentioned moisture varies in different coal seams; for this reason it might appear that its determination would indicate the seam from which the coal came. This is not true, however, for reasons above mentioned. If tests are expected to identify the seam which produced the coal other means must necessarily be employed.

However, in coal inspection service, moisture has been found to be very high in cases where delivery is by wagon, which, owing to lack of sufficient explanation of phenomena at the time, may have led to the opinion that the dealer wetted the coal for the purpose of increasing its weight at the time of loading. If this is the practice, it necessarily complicates the problem, but the writer has had cause to visit every coal yard in Chicago, and never observed any wetting of coal or any appliances for such purpose. It would be a difficult and expensive matter to wet fuel as loaded, and require water pipes located along team tracks, which in some cases extend for several hundred feet, and with the finer sizes of coal it would necessitate a man stationed at each wagon to supply water as fast as the coal was loaded, otherwise it would be impossible to add any great amount, because simply flooding the top of a wagonload of screenings, for example, would only insure the upper surface being wetted, as the water would not penetrate the mass. A further study of this matter has made it appear to the author, that this high moisture in wagon-delivered coal is due to the practice of wetting coal while it is being unloaded, very often done for the purpose of allaying dust, and to the water which is commonly added in the fire room for various reasons, both prior to the time of sampling.

This matter of moisture also complicates the problem as far as the inspection service is concerned, because it is impracticable for the inspecting company to have its sampler present when a wagonload of coal arrives, as it would entail an expense which the service could not bear. Also, sampling attempted at the time of unloading could not be properly performed, as the sampler would be unable to gather from a wagon at the sidewalk and prepare a sample as it should be done. Thus it appears, that the determination of moisture, even in wagon-delivered coal, serves no useful purpose. With fuel received in cars, there could, of course, be no opportunity for adding water.

Volatile Matter.

No fuel coal of this locality is purchased for the purpose of making gas or for use in by-product recovery plants, therefore tests for this constituent are unnecessary, unless there be a great difference in the coal. "Volatile matter" is not very well understood. The best conclusion is that coal is a complicated hydrocarbon which breaks down in distillation into various fractions, depending upon temperature and duration of heating period, and that the difference in coal of this basin is not greater than that due to the varying effect produced by the volatilization test itself; or, in other words, the variation may be caused by the test rather than by the composition of the coal. Thus the volatile matter test is not sufficiently accurate to be of service in this case. It is, of course, true, that it would distinguish between bituminous, semi-bituminous and anthracite coal, but one may do this merely by inspection without any test whatever.

All coal of this basin is high in "volatile matter"; all will make smoke if burned in sufficiently bad furnaces, and all will make smokeless combustion and good efficiency in good furnaces.

Fixed Carbon.

In coal analysis the disposition is to follow precedent. Coal mining became an important industry in the East long before it did in this locality. Much coal in the Appalachian basin is suited to the manufacture of a high grade of coke, and the amount of residue, or, in other words, the coke obtained under the conditions of the process, is a matter of first importance. This has had the effect of emphasizing the importance of "fixed carbon," so that it has been looked upon in many quarters as of more moment than any other chararteristic of coal, and these ideas, extending to our locality, have to a considerable extent influenced opinion regarding fuel. The same remarks regarding the uncertainty of the determination of volatile matter apply to that of fixed carbon, because the test for the former is the one giving data for the latter. If coke was made from coal of this locality, it would be possible under certain conditions, to make a use-

ful application of the test for fixed carbon: inasmuch, however, as it is not the case, this constituent is only a troublesome and misleading feature of analysis.

Sulphur.

Sulphur has been in a measure treated in the past the same as fixed carbon. In metallurgical work it is of extreme importance, and in this connection has received more attention than with fuel coal. This has given a prominence to the sulphur determination which it would not otherwise possess, and upon the assumption that sulphur is in the form of pyrites or very largely so, the conclusion has been accepted that the amount of sulphur is an indication of the tendency of the ash in the coal to clinker. This is true, however, to only a slight extent; in fact, may not even be considered as a working hypothesis in this coal basin, because some of the seams which are the highest in sulphur produce the least clinkering, therefore conclusions regarding the behavior of the ash in this respect are not justified by the amount of sulphur in the coal.

Evaporative Power.

This is something which should never, under any circumstances, become a feature of specifications or guarantees, for several very important reasons. In general, too many variable factors enter into the problem. For example, boilers differ, some being more efficient than others, absorbing greater or less amounts of heat from the coal for reasons due to their individual superiority or inferiority. Then furnaces differ greatly; in some cases all of the volatile matter may be burned; in others, a large portion be wasted. Again, fire grates differ in like measure, causing varying losses of fuel which falls into the ash pits, and the combination of grate and furnace has an important influence on the excess of air which necessarily enters, and for this latter reason, also, the useful result obtained from the coal is affected to a marked extent. The above refers to the characteristics of the apparatus itself, but at this point another and most serious variable must be considered, that of the personal equation of the fireman or furnace operator; therefore it is apparent that in such a test, one may be unable to discover whether the result is due to the fuel, the peculiarities of the apparatus or its manipulation. In the case of a coal purchaser who does not realize these facts, the result is always attributed to the object in view, which is, in such instance, to determine the value of the coal. If he had wished to discover whether he employed a good fireman or not, the experiment would have been precisely the same, and he would have then considered the result due to manipulation. It is not only the above features which have an important influence, but the character of the load on the plant is a matter of great moment. In a works where the boilers run steadily for twenty-four hours, the result secured, everything being equal, will be much better than in one where the work is necessarily interrupted by stoppages at noontime, shutting down at night, or with peaks of load, as in electric railway service. Any one of the foregoing causes may exercise a greater influence on the evaporative result secured than that due to variation in fuel.

It is not intended in the above to imply that coal-burning experiments are not useful, because there are some things which may be settled as affecting certain plants; for example, fuel high in ash generally costs less per ton than that containing less ash, and it might be a question which would be the most economical to use; or, the matter of the most desirable size of fuel may be in question. These two are the only features which can be settled by burning coal under a boiler, and they should not be made part of a specification or guarantee, but used entirely for the guidance of the fuel user in selecting the best grade.

The behavior of coal under boilers is a problem very little understood, because it is the result of many variable influences, and for this reason it is often felt that the calorimetric test is unreliable, which, however, is not true, because the calorimeter does its work very accurately as far as the coal itself is concerned; its efficient utilization in service is influenced only by the amount and fusibility of the ash associated with it and the size of the pieces of the fuel. This matter has been extensively treated elsewhere. (See Mr. Abbott's paper, presented September 5, 1906.)

It is well in this connection to direct attention to the fact that there is a feeling more or less prevalent, that coal from different localities or seams may possess some undefinable peculiarity in its chemical combination, which causes it to behave differently under a boiler than it would in a calorimeter. Such conclusion is untenable, because the process is identical in each case, that of combination of oxygen with the carbon, hydrogen and sulphur of the coal, and this combination can not be any different under the boiler than in the calorimeter, unless influences due to the peculiarity of the boiler apparatus and its manipulation assert themselves, and it is the disposition as far as the coal is concerned, to blame it for effects which are due to causes other than its chemical composition. It is well in this connection to call attention to the fact that the heating power of the coal proper, or, in other words, the pure coal in Illinois, only ranges from 14,000 as a minimum, to 14,750 British thermal units as a maximum, and that about eighty per cent of the fuel produced ranges between 14,000 and 14,500 British thermal units per pound. Thus the enormous variation found in service under boilers as far as the amount of water evaporated per pound of coal is concerned, is mostly due to the characteristics of the apparatus, its manipulation, and to the size of the coal and the amount of ash associated with it.

Thus it is very clear that specifications or guarantees covering amount of evaporation per pound of fuel or per cent efficiency, are not only useless but troublesome to the purchaser and dealer.

The three approved tests may now be considered, and while in the above classification they are presented in the order of greatest importance, it will be convenient to change their arrangement.

Pure Coal.

For better understanding, it is desirable to consider coal as the chemical combination of certain elements which are principally heat producing. The association of ash and moisture with these result in an aggregation which may be designated as fuel, although generally called coal, which, from this standpoint, however, is not correct, because neither ash nor moisture produces heat. The expression, pure coal, is the equivalent of what has erroneously been called combustible, the pure coal containing all of the combustible matter, and some water of composition and nitrogen which are not combustible, but as these two ingredients are associated chemically with the combustible the ultimate conception of coal is covered by this term, pure coal. Thus in the heating power determination, it is more to the point to base results on the pure coal than on any of the fuel mixtures, illustrated as follows: Let it be assumed that in one case the British thermal units per pound of dry coal is 13,250, and in another 12,450, from which it would appear that the two lots of fuel were different, but if the percentage of ash content in each is known, and the first sample contained seven per cent and the latter twelve per cent, it appears that each sample has a pure British thermal unit of 14,250, or, in other words, that the coal is the same in each, there simply being more ash associated with it in one case than the other. Basing the heating power determination on pure coal has another very important advantage, as it enables one to judge of the accuracy of analysis, because when the heating power and the source from which the coal comes is known, there is evidence indicating whether or not the analysis has been correctly per-

formed, because, if it has not been, it will be shown by the British thermal unit.

Ash.

An important reason why ash should always be considered as a percentage of the dry coal instead of the moist fuel is, that like the British thermal unit determination, unless it is placed on some common basis, proper comparison can not be made on different lots of fuel; for example, in two samples, the moisture may be eight and thirteen per cent, and ash in the dry coal ten per cent in each, but expressed on the moist coal basis, it appears that one has 8.7 and the other 9.2 per cent of ash, and it would seem that one of the fuels contained more than the other. In this connection the fact should be borne in mind, that no one burns moist coal; the moisture is evaporated and passes away; in fact, dry coal is not burned, the ash remaining; it being the pure coal which enters into the process of making fire.

Size of Coal.

As a general proposition, the value of fuel increases with the size of the pieces, so that a very fine "duff" is of little use, but as the pieces become larger, the actual value increases in a greater ratio than does the heating power, and this continues to egg size and lump. Thus smaller pieces containing the same amount of heat per pound as larger ones, are of less value than the larger coal. (See Mr. Abbott's paper, presented September 5, 1906.)

The size of the pieces of coal exercises an important influence not only on the capacity which may be produced by a boiler, but on the resulting efficiency, and the best size to be used in a given case is dependent upon many conditions, such as the strength of draught, kind of stoker or grates, method of firing, etc., and the selection of the proper size of fuel or the method of utilizing the available size often affords an opportunity to effect important economies.

Sampling.

One feature of the matter, referring especially to coal inspection service, is proper and reliable sampling. In very many cases the coal inspection service is rendered by a company, which, while acting as the purchaser's representative, is depended upon to furnish the seller with reliable reports concerning the composition of coal supplied. Under such conditions, it is absolutely necessary that not only shall the inspecting chemist be both competent and reliable, but that he shall be as fully responsible for the collection of the samples as he is for the analytical report, and it is also absolutely essential that the purchaser or his employees shall not be allowed to sample any coal or assist in the sampling, because under such conditions, the chemist may not know whether the report which he makes is correct or not, and it is well to emphasize the fact that the sampling is of as great importance as the analysis itself.

Referring to the branch of the subject before mentioned as that of research, there has been in operation for some years at St. Louis, what has been designated as a fuel-testing plant, under the direction of the United States Geological Survey. Its principal published work so far, however, has been largely confined to "tests" under boilers, which have been thought to show the "real steaming value" of the fuel. The author's remarks above regarding testing coal under boilers will refer to this branch of the work.

Probably the reference to coal in the plural has done much to cause confusion, because it has led people to believe that there are very many "kinds" of coal. For example, fuel from Herrin and Carterville in this state would, according to this, be considered as different "coals," when, as a matter of fact, they are from the same seam, and the most exact analytical tests so far made do not indicate a difference. The amount of ash associated with the coal may or may not vary, but the coal is the same, and it is coal and not coals, otherwise, every mine would produce a different kind of coal, notwithstanding the fact that seams in Illinois sometimes run through an entire county without it being possible to detect any variation in the quality; therefore, the expression, "kinds of coal," which has been used frequently in connection with coal-testing work, should not only be better defined, but limited in its application to those cases where there is a real difference, which, as is well known, does exist; for example, it must be conceded that anthracite and bituminous are different kinds of coal, but the most liberal application to this coal basin would allow only two kinds, which are the block coal of Indiana, all the remainder being bituminous, the latter also including what is known as semi-block of Indiana.

The State of Illinois has made an appropriation covering cost of investigations to be conducted by the engineering experiment station of the University of Illinois, and there is certain important work which it is hoped will be undertaken, having a bearing on the values of fuel, studies tending to define the laws controlling the influence due to the size when burned with some different kinds of stokers or grates, and similar studies to ascertain corresponding effect due to varying amounts of ash in coal, also degree of fusibility of such ash.

The recently-established State Geological Survey will present by all means a very much better coal report than has so far been published by any state, and it will be a great help to the purchasers and producers of coal, if certain values as affecting heating power, ash and moisture are authoritatively presented. As before mentioned, the three essential items are heating power of the pure coal, percentage of ash in the dry coal, and moisture. The British thermal unit values would be the simplest of the three, as these results would apply to pure coal, and which is, no doubt, practically a constant for a particular locality of a seam, therefore, once determined, it will not be necessary to repeat tests. Establishing ash values would be a more difficult matter, because it would not only involve ash in seams as the coal lies in the ground, but the various grades of fuel shipped from those seams. Ash, however, at the mine would be the same in quantity as when received by the consumer. Securing moisture values would be a far more complicated problem, because of greater variation due to temperature, weather conditions and time in transit. For these reasons, it is difficult to arrive at any conclusion regarding the amount of work which may be justified in the establishment of such values. Some idea of the complication may be illustrated; for example—the washed and sized coal shipped so extensively from Williamson County has a characteristic moisture content due to the difference in the size of the pieces, the larger ones being drier, and these moisture contents vary over wide ranges between summer and winter, and also according to the length of haul; thus at least average moisture values would be needed for each size, at the city where the coal was received.

A recent expression which has come into use is that of "air-dried coal," which is based upon allowing the sample to become dried in the open air of the laboratory, the idea being that this shows the fuel as it would reach the customer. No standard conditions, however, appear to be employed in this air-drying, and if there were, the values obtained thereby do not indicate the amount of moisture in coal when it reaches the consumer. Some samples of air-drying on Illinois coal have shown the moisture as being between five and six per cent, when as a matter of fact, the same coal is never received with less than seven, and in the winter time it is very much more. This moisture value should be abandoned, as it serves no useful purpose, tending only to increase existing confusion and misunderstanding.

INCANDESCENT GAS LIGHTING.

On December 19th L. F. Tooth read a paper before the S. Dist. Jr. Gas Assn., in London, England, from which the "Gas World," (December 22d) made extracts; among them the following will interest our readers:

Speaking of pressure, the author said that he found that incandescent burners working under 3 ins. pressure gave vastly better results than under the old 1.5-in. conditions. "The advantages are: The consumer has more opportunity of getting smaller gas accounts, because, in the event of the burner roaring, or the flame passing over the top of the mantle, it appeals to him at once that the burner requires adjusting and, if under maintenance, he will either notify or take some steps to remedy the error. Pipes can be reduced to half the size of those required for very low pressures, reducing the initial cost and at the same time limiting that ugly appearance that large ones have been running through the building. Complaints of bad lights and stopped supplies are reduced to a minimum. The nipples will not get choked with dust so quickly. The mantle has more chance of adapting itself to the flame and vice versa. It will become well filled and incandescent to the top, reducing shrinkage to a very great extent. Increased pressure prolongs the life of the mantle, as it becomes hardened and crisp after being burned for a short time. To show the increase in efficiency as pressure increased, he submitted tests of a No. 4 Kern burner, different sized nipples being used to obtain the best results at each pressure, as follows:

Pressure Tenths	Consumption of gas Cubic feet	Illuminatng power Candles	Average candle power per cubic foot of gas
15	4.9	90	18.3
20	5.5	103	18.7
30	5.1	100	19.6
40	5.5	120	21.8
50	6.3	142	22.7

"The simplest means of checking the gas supply is at the meter tap, or at each individual point, or a still better method is the 'gas adjusting nipple.' By the use of this nipple, you can obtain an equal duty in every spot. A gas adjuster has advantages over air regulators, because the slightest decrease or increase in the volume of gas creates a rapid change in the lighting efficiency that is at once apparent to the eyesight. It is also very useful in high-pressure lighting, as it is often necessary in certain parts of the building, such as staircases, lavatories, etc., to revert back to low pressure; in this case, the nipple displaces the use of governors. Makers would do well to give their serious attention to this, as it would be the means of relieving them of the necessity of making special nipples for individual companies' districts and entirely do away with the annoyance of stocking different sizes to cope with the local conditions of any individual consumer. In adopting the adjustable nipple, it is very necessary that it should be of very fine manufacture and made perfectly true and with very smooth edges. Better results are obtained from one that has a central adjusting movement, because I contend that gas should impinge from the nipple in the direct center of a bunsen tube and not by shutting off one, two or three of a number of holes, as the case may require. To illustrate the value of the nipple, I fitted a No. 4 Kern burner with one and the photometrical readings were as follows:

Pressure Tenths	Consumption of gas Cubic feet	Illuminating power Candles	Candle power per cubic foot of gas
15	4.4	87	19.7
20	4.7	95	20.2
30	5.2	115	22.1
40	6.0	138	23.0
50	6.3	153	24.2

"Comparing the above figures with those of the ordinary nipple I have given, it clearly proves that the adjustable nipple is going to play a very prominent part in gas lighting.

"In mapping out an installation, in most cases there is no absolute hard and fast rule to work by, such as candle power per foot of floor space, because each individual consumer's requirements and conditions differ. It is really a matter of experience to determine the amount of light required for a given area, but the rule of one candle for every 3 square feet of floor area is a very good standard to work upon, assuming, as a basis, the room to be lighted to have a white ceiling and walls and lights placed 9 feet high, increasing the power according to the color of walls, decorations or obstructions. An increase of 5 to 7.5 per cent in candle power will usually suffice for every foot over 9 feet in height. Color and tints of globes have also to be considered when working to the standard just given. The general public, to my mind, have a great tendency for increased light, which is certainly very harmful and destructive to the eyesight, especially the rays given from the electric arc, which we see so often used for inside lighting. Therefore, this is another point we have to consider in getting our light well diffused in small units, with soft, mellow tone and I always endeavor in inside lighting to tone it down to resemble the evening light, which is very restful and pleasing.

"All lights, as far as possible, should be hung from the ceiling and every endeavor made to have the mantle suspended in a direct line with the cup and ball, so that, when globes or any parts are removed for cleaning purposes, the mantle is left still in the vertical. Tee pendants and all fittings of this class should be avoided, because, according to the weight of removable parts, so the mantle is thrown out of the vertical line. This causes the mantle fringe to break and also strains the loops and shoulders. I estimate these fittings increase the maintenance cost at least 33 per cent. The disadvantage of this class of fitting applies more to the upright than to the inverted burner, as the clay rings take up the strain. Fittings should not be used without a cup and ball pinned top and bottom. Pendant drops over 5 feet should be pinned at every joint, particularly at the tee-piece of bridge under floor and ceiling."

In a brief reference to church lighting, Mr. Tooth pointed out that the fittings should be such as will blend with the building and, if inverted burners are used, provision should be made for some of them to be turned out, as he could not understand inverted burners being lowered, despite what had been said in the "Gas World" in reply to Mr. Fletcher, of the Welsbach company. In regard to factory lighting, he said he thought the inverted burner would, in the near future, play a very prominent part in lighting sewing machinists' shops. He found the Bijou burner, with shade, exceptionally reliable in providing ample light for one machinist dealing with long lengths of cloth and sufficient for two dealing with small work, providing the machines were facing each other and the light placed so that it was thrown on the right side of the needle. As to vibration, to overcome this he had not yet found anything to surpass the elongated spring; compressed or lateral was of no use whatever, and did more harm than good. A fitting suspended from cup and ball, having practically the whole of its weight at the bottom, would take up a certain amount, where buildings were near railways and places where vibration was of a slight character. Fittings suspended by chandelier chain and also flexible metallic tube, took up a considerable amount of vibration, but in the latter case the fitting should be a very light one. In regard to yard, wharf and dock lighting, he said this should be done by units of from 100 to 250 c. p., placed about 12 feet high and the side of the lamps next the river should be glazed with ground glass, as shadows cast upon the water were exceedingly dangerous to river traffic. The 16-inch square lantern was best suited for this class of work, as the wear and tear was heavy and the cost of repairing these lanterns was less than that of the globular type.

"Great care should be exercised in the fixing of lamp arms. They should be run through the facia to the internal

part of the building and secured by means of a plate and back nut, the flange of the arm acting as a stop. It often happens that supplies must be run on the front, on account of roller shutters, sun blinds and large glass facias. In this case a flanged tee-piece will provide the connection for arm and back plate, the arm being stayed to take the strain.

"Lamps require to be of good manufacture and strongly made; and care should be taken not to crowd too much power into them, as this increases wear and tear. Large arc lamps seem to be going out of date and the smaller lamp, 2 feet over all with 11-inch globe, coming into more popular use. There seems to be a great tendency for 4-burner lamps. Why, I cannot understand. You can get practically the same results with 3-light, reducing wear and tear and gas consumption 25 per cent and giving the consumer more satisfaction.

"Cluster lamps should be used in preference to single burner, as you have always a fall back in case of breakage of mantles. All cups and balls should be fitted with safety guards.

"I do not think that maintenance should be run at a heavy loss, even as an advertisement and should certainly return the cost of material and labor. To my mind, supervision, management and establishment charges, is quite sufficient loss to warrant the satisfaction of consumers.

"Details of each consumer's installation should be kept, including position, description of lights and provision made for remarks in the event of any peculiarities, such as excessive vibration, abnormal dust and situation of premises, such as over railways, etc., so that you always have at hand a ready reference for any future occasion. In organizing a maintenance staff, it is absolutely necessary to employ the most skilled workmen available, as on them the working results largely depend. As the result of my experience, I find that it is false economy to employ cheap labor on such delicate work."

RULES FOR INSTALLING GAS PIPING.

Inside Piping.—Almost all architects' specifications now call for the piping in a building to be done according to the rules of the gas company and the gas company usually adopts such rules as will insure that the size of the pipe used will be of ample capacity to carry the amount of gas it is expected will be needed with a differential pressure not exceeding one-half an inch of water. They also specify that the work shall be done in such a manner as to insure as far as possible the safety of the occupants of the building. The following rules for size of pipe for inside piping were adopted by the American Gas Light Association, in 1898:

Diameter, Inches	Length, Feet	Gas per Hour, Cubic Feet
⅜	20	11
½	30	22
¾	50	60
1	70	127
Diameter, Inches	Length, Feet	Gas per Hour Cubic Feet
1¼	100	222
1½	150	349
2	200	718
2½	300	1,253
3	450	1,977
4	600	4,059

No greater length of pipe should be used than is given in the table; e. g., the maximum length of 1-inch pipe allowable under any circumstances is 70 feet, and it should not be expected to carry over 127 cubic feet of gas per hour.

One of the natural gas companies where gas is largely used for fuel, has adopted the following rules governing the size of the pipe and the method of installation:

Gas for Light.—No pipe less than ⅜ inch.

Size of Pipe, Inches	Greatest Length Allowed, Feet	Greatest No. ⅜-inch Openings Allowed
⅜	12	2
½	30	3
¾	60	10
1	70	15
1¼	100	30
1½	150	60
2	200	100

Gas for Fuel.—No pipe less than ½-inch.

Size of Pipe	Greatest Length Allowed	Greatest No. ¼-inch Openings	Instead of ½-inch Openings there may be		
			½	and ⅝	or ¾
½	15	1	1	..	..
¾	50	2	1	1	1
1	70	4	2	1	2
1¼	100	8	4	2	4
1½	150	15	6	4	7
2	200	33	14	8	15

All new piping must be tested with a mercury gauge and shall be made tight at a pressure of not less than 4 pounds or 8 inches of mercury. No spring gauges will be allowed. The gas company must be notified of the completion of any job so that it may inspect the same, should it deem it necessary. The riser pipe in any building shall not be less than ¾ inch and must go in an inside partition wall and out of reach of frost, and must not project more than 2 inches below the cellar joist. No traps in the riser will be allowed. Drop or bracket outlets must be securely fastened. Split pipes must not be cemented, but the pipe must be taken out and a perfect piece substituted. No cast iron fittings will be allowed, only the best malleable iron fittings galvanized. In case more than one consumer wishes to use gas in a building a separate riser must be run for each consumer. In no case will a meter be set where the gas passing through that meter must be deducted from another meter through which it has previously passed. Piping shall be so arranged that the meter can be placed in a position easy of access and exposed to neither dampness nor extreme heat or cold. The meter should be placed as near where the service enters the building as possible. Suspended pipe must be securely fastened. No strings, rope or wire should be used.

In addition to the above the following notes may be of interest:

For this work it is advisable to use the best quality of wrought iron pipe obtainable, as this insures that the threads will be cut without stripping and there will be less liability of split pipe. The fittings used are preferably malleable iron, beaded, and the best practice is to use galvanized fittings since the galvanizing has a tendency to fill up whatever sand holes or porous places there might have been in the original casting. For the dope on the threads any one of the various compositions given under "Wrought Iron Main Laying" may be used on male thread only.

Care should be especially taken that all openings are securely fastened. There is now on the market a malleable iron drop fitting having lugs or ears projecting from the side for the purpose of fastening. The use of this fitting makes it easier to fasten the drop and would also prevent the liability of the drop being unscrewed when the fixtures are taken off. No unions should be allowed to be used, as it is almost impossible to make the work come so exact that the two faces of the union will press against each other, making a tight joint without the use of a washer, and unions with which the joint is made by a washer are much more liable to become leaky than long screws. The long screws are cheap and make a joint that is tight or as permanently tight as any other joint.

Testing Inside Piping.—After the piping has been completed it should be tested to see that it is perfectly tight. It is customary for the plumber to first ascertain if his job

is tight, and after making sure that this is the case, to ask the gas company's inspector to make the final examination. The plumber should see that all openings are carefully closed with caps and that the foot of the riser line is stopped. Then at any convenient sidelight attach an ordinary gasfitter's pump and mercury gauge. This mercury gauge should have a column of 15 to 20 inches in length. Air is forced into the piping by means of the pump until the mercury column has been forced up about 10 inches high in the gauge, when the pump is shut off. If the mercury falls there is a leak in the pipe; if it remains stationary the pipe is tight. It is customary to require that the mercury remain stationary for from 15 minutes to half an hour. If the mercury falls rapidly it will indicate there is quite a leak and this leak will be heard to blow. If the leak is caused by a piece of split pipe or split fitting the pipe or fitting should be removed and a new piece substituted. Gasfitter's cement should not be used for repairing leaks. If the leak cannot be heard blowing, either may be put into the hose of the air pump and the pumping of the air into the pipes will carry the ether into the pipe. The odor of the ether escaping will indicate where the leak may be found in the pipe and it may be definitely located by means of a strong soap water applied with a brush or sponge. The liquid is rubbed over suspected joints or fittings and air bubbles are blown by the escaping air. In very large work it is advisable to prove one floor or one section at a time and when all are done connect them with the riser and prove as a whole. If the pipe to be tested has been previously used for gas and you have to test for leaks, it will be necessary to take off the meter and cap the bottom of the riser; also to take off the gas fixtures and cap the outlets carefully, as it is impossible to test pipe with the fixtures on and find it tight. The ground joints in the stopcocks of the fixtures almost always leak when the pressure is put on them. Sometimes plumbers, when they have a small leak and are unable to find it, or if it is concealed in a partition where it is impossible to get at it to repair, will fill up the house piping with water containing salt or ammonia solution, hoping by this means to rust the leak tight. They are almost always successful in doing this, but the practice should be condemned, for after the water has been drawn out of the pipe the ammonia and salt still continue to rust the pipe and in time this rust will collect in some one place and stop up the system.

Some gas companies require that the gasfitter file at the gas office a sketch or plan showing the size pipes run and the length of each piece. This plan is filed previous to inspection. The company's inspector checks up the sizes to see that they comply with the rule. He afterwards examines the piping in the house before it is concealed, and if the piping is according to the rules of the company he gives a certificate to the effect that he has inspected and found it to be tight and to comply with the company's specifications. It is stated, however, in the certificate that the issuing thereof does not insure its future soundness. At the time of the setting of the meter, or at the time when the gas is turned on, a second inspection is made, this time of both the pipe and the fixtures, and in case these are found tight the gas is turned on.

FUTURE DEVELOPMENT OF HEAT ENGINES.

By E. N. Percy.

The interesting and able contribution by Prof. Burstall, in "The Gas Engine," was read with interest by the writer, who is studying the subject in Germany.

Prof. Burstall, in common with many, assumes that large powers for gas engines are most successfully incorporated in huge horizontal, slow-speed engines, closely resembling, in design, the steam engines of a decade ago. Why not make use of high-speed multi-cylinder, vertical engines, and borrow a little knowledge from modern steam engine practice? The best running and most economical steam engines we have at present (though not the cheapest) are the single action. They run silently, because the forces are always in one direction. This type applies also to a two-cycle gas engine and is even more economical, because the cylinder temperatures remain almost the same, there being no reversal of temperatures.

The fact that a gas engine is to be treated as a gun in design because of high initial pressures, and that governing is a complicated problem, can be overcome by the same methods; i. e., substitute those neglected and abused types of engines in which the fuel, liquid or gas, is injected after the air, and during the power stroke, and burned as injected, whether by high compression, hot tube or continuous electric spark, it makes no difference. Then, there will be no explosion, nor any increase of pressure above compression, and the fuel supply can be governed exactly to suit the load, and governing is as perfect as in the steam engine. The various engines of this type now on the market are by far the most economical we have, some running on fifty per cent. of the fuel of an ordinary four-cycle gas engine.

In regard to the gas turbine, Prof. Burstall assumes that seventy-five per cent. of the output does negative work. To overcome this objection, could not all this heat be rejected into the pumps, and various parts of the turbine be made to boil water, and the same injected into the turbine, as in a certain well-known make of engine, and there, by actions whose result only is known, render the turbine quite economical? Furthermore, the "pumps" to which reference is made, would, of course, be rotary turbine-pressure blowers, or air compressors, through which air passes so quickly that the losses might not be as large as expected. As to the cooling of the blades, it can be done in any one of several ways, but whatever method is used, the heat must be saved, and, in the writer's opinion, used over again, instead of passed to another machine. This could be done, by using it for steam, to heat the incoming charge, or to heat a low-boiling liquid to run a turbine on the same shaft, possibly built around the main turbine, so as to absorb its heat.

As to the reversibility and flexibilty of the gas engine, a two-cycle, three-cylinder, vertical engine, of the fuel injection type, in combination with compressed air and cocks to let the starting charge of compressed air in through the fuel valves, will start, handle and reverse with all the ease and certainty of the steam engine, and all with the handling of one lever.

The writer has actually seen this done, and knows whereof he speaks.

In looking over the past, we find the greatest progress has been made by those who disregarded conventionalities and the opinions of the ever-present "let-good-enough-alone" types, and arbitrarily "did it." No doubt many people told Diesel, Meitz and others that their engines would never work. No person should ever ridicule an idea, and the practical man who laughs at ideas will in a few years regret it. Hence the writer's frank admiration for those who, like all scientific men, look into the future, and speak boldly of it, and discuss it freely. Invention is not a matter of genius, but becomes more and more the result of scientific evolution.

ELECTRICITY ON THE FARM.

Not content with his several crops a year and other manifold advantages, the western farmer is preparing to harness a multitude of miniature Niagaras which leap downward from their sources in the mountain tops, and make them generate enough electricity to render the arduous tasks of agricultural endeavor mere child's play.

Though the idea may appear impracticable at first blush, any electrical engineer familiar with the power of mountain streams will admit that it is not only possible and, moreover, feasible, but that its possibilities of application are as limitless as electricity itself.

Many of the richest grain and fruit farms in California are situated on the slopes of the Sierras which create the fertile valleys in all parts of the State. The fruit, grains and vegetables grown on these mountain farms is said to possess a richer flavor and command a better market than that which is garnered from the widespreading lowlands, but the mountain agriculturist suffers handicaps from which his brother of the valley has hitherto been exempt.

There are certain mining districts which would be the richest in the world if they could be worked to advantage, but which, under present conditions, are almost profitless. The same may be said, in a small degree, of all western mountain farms, for though, even under adverse conditions, they yield a good return, they would net their owners a tenfold larger return with the benefits the electrical farming movement hopes to develop.

The movement, moreover, is far more than a theory. It is a practical reality on a small number of farms and its scope is being so rapidly extended that another decade may prove the electrical farm the rule rather than the exception in the Golden State.

What electricity will do on a farm may be seen in Solano and several other counties in California. In one instance, the farmer had command of a small stream with about 4,000 gallons flow per minute under normal conditions. A flow-type dam, 30 feet long and 4 feet wide, was built across the stream, the water being diverted through a ditch about 100 feet long, giving a fall of five feet. At the lower end of the ditch, a wheel pit, laid in concrete, was constructed and over this a small power house was built. In this a 30-inch water wheel was installed which operated a dynamo of 12½-kilowatt capacity. This is a plant which runs all the year around, requiring only a little attention twice a week. It is equipped with a governor which regulates the electricity according to the demands made, but it never stops, night or day, and at any time the turning of a switch furnishes light, heat or power.

Primarily used to lighten the labor of a dairy, it was but a step to attach a belt to the grindstone and install an electrically operated buzz-saw that made the cutting of the winter wood comparative child's play. The "women folks" were next made beneficiaries of the subtle power which the little stream so blithely developed and electric lights did away with the labor of caring for kerosene lamps; a motor was attached to the sewing machine and backache banished from the housewife's ills; electricity operated the windmill and filled the tank with water when the days were provokingly calm; an electric flat-iron made its appearance; electrical fans cooled the house in Summer and electrical heaters made it comfortable in Winter.

One would think that the possibilities of usefulness for this little mountain stream were about exhausted with the above list of conveniences, but the fact is that, on the contrary, they have only begun to be suspected. The most important use of all has not yet been broached; i. e., the supplanting of horses by electrically driven farm implements and by so doing to so simplify the work that one man may perform the tasks of three under ordinary circumstances.

It is estimated that three farmers may build, for an outlay of $1,500 each, a power plant of sufficient capacity to do all the work on their combined farms at a saving to each of $900 per year in hard cash and many times that amount in comfort and convenience to all concerned.

THE STRENGTH OF ELM, OAK AND LOCUST INSULATOR PINS.

At the request of certain consumers, the Forest Service recently made tests on fifty-three insulator pins of rock elm, live oak and black locust. The tests were made at the timber-testing station of the Forest Service at Purdue University, Lafayette, Ind. The results indicate the relative strength of the pins tested. They depend upon too small a number of tests, however, to show in an authoritative way the relative value of these woods.

The pins were of standard size, one and one-quarter inch by eight inches. The oak pins were from one-eighth to one-quarter inch shorter than the others, and of slightly smaller diameter at the shoulder. Their lever arm was also about one-half inch shorter than in the cases of the other two species.

In testing the pins an iron block was clamped to the fixed upper head of a small screw-testing machine. The pins were inserted to a tight fit in a hole in this iron block, and projected horizontally over the pulling head of the machine. The glass insulator was unable to bear the strain of the wire, so an iron model of the ordinary glass insulator was screwed on the pin and connected by means of a heavy wire to the pulling head of the machine. When a strain was put on this wire, the pin acted as a beam fixed at one end and loaded at the other, which is practically the condition met with in practice. The breaking moment (maximum load times lever arm) is taken as a measure of the strength of the pins. The iron block mentioned was used in preference to a wooden cross arm for supporting the pins, for the reason that this iron block forced the pins to break under the test. Furthermore, it furnished uniform conditions for all pins. Thus, the results of the tests do not show the strength of a combination of pins and cross arm, but they show the bending strength of the pin itself.

The following table gives the results of the tests:

Species	No. of tests		Weight of pin Grams	Rings per radial inch	Breaking moment (Max. load x lever arm) (Inch pounds)
Black locust,		Avg.	106.3	12	3970
from Boston,	23	Max.	119.3	25	5380
Mass.		Min.	86.6	3	2520
Black locust		Avg.	125.9	8	4087
from Nashville,	7	Max.	147.1	11	4930
Tenn.		Min.	111.8	4	3010
Rock elm		Avg.	93.8	42	2512
from Nashville,	8	Max.	108.7	48	3150
Tenn.		Min.	77.5	33	1450
Live oak		Avg.	127.1	Not dis-	3025
from Houston,	12	Max.	141.0	tinguish-	4590
Texas		Min.	110.4	able	1990

From the table it appears that the breaking strength of the two shipments of black locust pins was practically the same, and may be taken as 4,000 pounds. Live oak pins came next in order of strength, with a breaking moment of about 3,000 pounds. Rock elm pins were the weakest, having a breaking strength of 2,500 pounds.

The oak pins were the heaviest, the locust next, and the elm the lightest.

The locust and elm pins failed mostly by splitting from the threads to the shoulder, or by tension at the shoulder. Occasionally the portion of the pin inserted in the block failed by shearing horizontally. The oak pins nearly all failed by tension at the shoulder.

Mr. Bonaparte, Secretary for the United States Navy, has laid before Congress plans for a battleship similar to the Dreadnought. The chief dimensions of the new vessel are: Length, 510 feet; beam, 85 feet 2⅝ inches; draught, 27 feet; displacement, 20,000 tons; coal capacity, 2,300 tons; speed, 21 knots. The plans have been prepared by the Bureau of Naval Construction. The ship will have a broadside 5.25 per cent more powerful than any battleship yet built, and the elevation of her guns will also be greater than is the case in any other vessel, thus giving her increased long-range fire. Her defensive qualities will also be distinctly superior to those of most modern vessels of her class. The armament will consist of ten 12-inch guns and fourteen 4-inch quick-firers, besides a number of small machine guns to repel attacks by torpedo boats. The cost of the vessel is estimated at $6,000,000.

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EDITORIAL.

Engineering and Labor

There is probably no question before the people of this country at the present time of greater importance than the proper remuneration of the working man and the relation of labor of every character to the financial interests. The past five years have been a period of remarkable prosperity and development. Engineering in some form or another has been identified in a marked degree with this material development. Enormous sums of money have been expended, and labor has been in great demand to carry out the large projects connected with engineering enterprises of a magnitude heretofore unknown.

Engineering has always been an important agent in increasing the wealth of mankind and the independence of laborers and mechanics has been greatly advanced in consequence of the vastly increased demands upon their services due to engineering work. Great as have been the strides in engineering, the advance in the progress of civilization has been equally important. In 1834 laborers attempting to form a trades union were sentenced to seven years penal servitude. In England two centuries ago carpenters and masons working twelve hours a day received 24 cents in wages, while common laborers received 16 cents a day. Due to the lack of transportation the prices of every commodity varied widely throughout the country and ranged considerably above the present prices. Meat was practically beyond the reach of the poorer classes. These conditions continued until near the end of the eighteenth century, when there began in England the slow progress of an industrial revolution which has continued with ever-increased intensity in all civilized countries to the present day, and this industrial development has changed the whole course of civilization.

The invention of the spinning-frame and the spinning-jenney multiplied the product of cloth per weaver at least twenty times. Watts' double acting steam engine gave an immense impetus to the factory system. Whitney's cotton gin resulted in giving to the entire world cheap cotton. In 1807 Fulton, and in 1825 Stevenson, gave to the world the result of their work, which has given to civilization cheap transportation. Early in the nineteenth century the invention of the hot blast greatly increased the output of iron products, and at the same time materially reduced the cost of production. A few years later the invention of the telegraph, harvesting machines, and new machine tools for iron and wood working increased the demand for men trained in the elements of engineering. About three quarters of a century ago, therefore, witnessed the introduction of what is now the most important machinery of industry, and upon which our modern civilization to a large extent depends.

There can be no question that the one invention which has been of the most importance in modern life is the steam engine. Its application to transportation both by rail and water would, independent of all other applications, probably give the steam engine first place among all inventions. All wealth, say some economic writers, is the product of labor. If the labor meant is human labor only, the above statement is not absolutely correct. Human labor produces wealth when properly directed in utilizing the natural forces of nature, but the same is equally true of the labor of horses, water wheels, or the steam engine. In Great Britain it is said that steam does more work than could be done by 150,000,000 men, and in the United States steam power is said to accomplish more than 250,000,000 men. In America, during the last twenty-five years, the use of steam power has increased nearly three times as rapidly as has the population. Steam, water and electric power is constantly increasing the wealth of the country. If as is said the increase of wealth in the United States at the present time averages $10,000,000 daily, steam, water and electric power must be given credit as primarily responsible for a large part of this enormous sum.

In 1880 the average annual wages in the United States for each factory employe were about $350. Ten years later they had increased to nearly $500. Statistics at the present time indicate that the average annual wages of the employe of the manufacturer are nearly $1,000. The total value of the products of all manufactures has increased since 1880 about 150 per cent, while the wages paid have increased 200 per cent. From 1890 to 1900 the population of the United States increased approximately 25 per cent. During this same period carpentry products increased 200 per cent. Men's clothing manufactures increased 80 per cent. Foundry and machine products increased 92 per cent.

Iron and steel products increased 85 per cent. Lumber and mill products increased 73 per cent, while planing mill products increased 150 per cent. Masonry, brick and stone increased nearly 900 per cent. Printing and publishing increased more than 200 per cent, while the output of the meat packing houses increased 86 per cent.

The only conclusion to be drawn from the above figures is that the products of what are for the most part engineering enterprises have increased in total value far greater than the increase of population. The increase in wages compares favorably with the increase in the value of the manufactured products, and in as much as these manufactured products consist of raw material to which manual labor is applied, it is apparent what an enormous benefit the increased use of machinery has been to improve the wages of the working men and increase their comfort of living.

There can be no question in the mind of any intelligent man that engineering is the greatest cause of the increase of wealth in the last century, and yet there has always been more or less opposition by the working men to the introduction of new machinery. As late as 1867 a British commission reported that restrictions had been placed upon machinery by trades unions, which restrictions were based apparently upon the idea that there was only a certain limited amount of work to be done in the country, and that if any man increased the amount that he did, whether by the use of machinery or otherwise, he was thereby robbing some one else of the opportunity of working. Nevertheless, the effect of the introduction of labor saving inventions and engineering appliances has been to benefit the working man. This is most conclusively shown by the actual necessity that exists that capital or wealth cannot accumulate except by the employment of labor, and the more wealth is increased by the development and utilization of nature's resources, the greater still must be the demand for labor.

REINFORCED CONCRETE AQUEDUCTS.

The use of reinforced concrete for carrying water is extending, and there are now several instances of the application of this material for aqueducts. One of the most notable is that used in connection with the Simplon Tunnel works in Switzerland. To carry water from the River Rhone to the power plant, a conduit consisting for part of its length of a concrete-steel flume and for the remainder of its length of a cylindrical steel penstock was employed. The concrete-steel flume was rectangular and 1.9 m. by 1.9 m. (6.23 ft. by 6.23 ft.) in section, and was 2 km. (1.86 miles), with a grade of 1.2 m. per kilometre. The roof of the conduit was designed to carry a superimposed load of 800 kgs. per square metre (164 lbs. per square foot), and an internal upward pressure of 300 kgs. per square metre (61.5 lbs. per square foot). The flume is supported on piers of masonry or bents of concrete-steel spaced 5 m. (16.4 ft.) apart. To provide for expansion and contraction during construction, open joints were left over the piers; these were filled before turning the water into the flume. With the water in the flume there is very little expansion or contraction of the structure. The few leaks from percolation were soon closed by the lime in the water. The cost of the flume was 100 francs per lineal metre, or only about 10 per cent more than the estimated cost of a wooden flume of the same dimensions.

WIRELESS TELEPHONY.

It is reported in the Paris journals that M. Maiche has made a further discovery in the field of wireless telephony. His apparatus consists of two posts, which are placed in his premises. Each post consists of a telephone, battery, a special form of induction coil, and a frame which is formed of a series of insulated wires. One post is placed in the garden, and a second one in a room in the building some distance off, about 100 feet, and several walls, doors, and windows come between the posts. Conversation can be carried on easily, and the sound is clear. M. Maiche started to work on this question about five years ago. At the chateau of Marchais he made experiments, using the earth as a conductor, and these were successful at a distance of two miles. One year later he was able to communicate between Toulon and Ajaccio, in Corsica, over the sea, at 180 miles distance, using the sea as a conductor for the waves. The new apparatus, however, works without the use of ground, and M. Maiche expects important results to follow from its use, and also to increase the distance indefinitely by giving more power to the apparatus. It is thought that the system could be used with advantage on submarine boats. In spite of the reported discovery, there is nothing to show that any practical progress has been made.

TELEGRAPHS IN INDIA.

The whole of the telegraphic system of India is to be overhauled and put into a better condition. A committee, which is now holding its preliminary sittings at Simla, is to make a tour of inspection throughout the country. There are over 200,000 miles of telegraphs in India and about 2,000 telegraph offices, but complaints have been made of the inefficiency of the service. The Deputy Controller of the central telegraph office, London, has been sent out to India to give assistance in reorganizing the service.

LAMPS.

The Franklin Institute has published a pamphlet containing the report of the Committee on Science and Arts, on the William J. Hammer collection of incandescent lamps, which was exhibited at the St. Louis Exhibition in 1904. The collection was started in 1879 and contains lamps showing practically every step in their development, from Edison's early platinum thermostatic regulator lamp to the new lamps of the present day. The report contains extracts from letters written by eminent men prominent in electrical science and development, congratulating Mr. Hammer on the historical value of his collection.

What Mr. Hammer's own ideas are, are admirably stated in the editorial note which supplements the report. This is as follows:

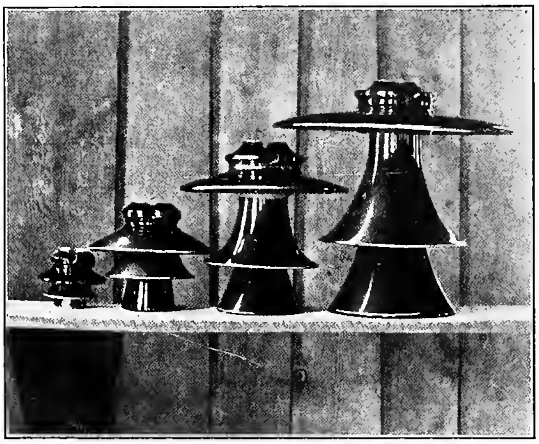
"It is Mr. Hammer's earnest wish that this collection shall be kept absolutely up-to-date as time passes, that it may always represent a complete History of An Art, and to this desirable end he will always lend his enthusiastic cooperation. This has always been his wish and intention, and in the years past he has been buoyed up in his laborious task by the hope that his work, if successfully carried out, would stimulate others to make similar collections forming priceless records of the inception, development and perfection of other arts, and perhaps ultimately result in an engineering museum in which engineers could deposit their models and inventions, where they would be properly safeguarded, where they would be of infinite interest to the world at large, where they would be of great service to the historian, where they would be a constant stimulation to the young engineer and to the inventor, and where they would be of enormous educational value to all engineers.

INDUSTRIAL

THOMAS HIGH TRANSMISSION INSULATORS.

In the development of high-tension transmission lines and the work that has been accomplished in this direction within ten years, no one item has been a greater factor than the high tension insulator.

About 1896 the R. Thomas & Sons Co. of East Liverpool and Lisbon, Ohio, who have been engaged in the manufacture of electrical porcelain for low tension work for many years, began investigation of the question of manufacturing a high-grade porcelain insulator for transmission work. Before attempting to put any of these insulators on the market they thoroughly investigated the situation to ascertain what would be expected of the insulators and learned that the conditions would be most severe, both mechanically and electrically. While such porcelain as they had made in the years past was recognized as standard quality, the process of manufacturing



THE FOUR INSULATORS SHOWN ABOVE RANGE IN SIZE FROM 5 TO 21 INCHES IN DIAMETER AND FROM 5 1-8 TO 18 5-8 INCHES HIGH.

for high tension work was an entirely new problem. They therefore began, and carried on, for upwards of eighteen months, experimental work, to secure a body and glaze that would bring about the result desired, namely, a highly vitrified insulator, homogeneous and capable of standing great electrical strains, and, at the same time, show unusual mechanical strain. Their efforts were in the direction of testing out all known clays, both domestic and foreign, and after a long series of experiments, they found that the high-grade foreign China clays gave the best results. In 1897 they developed one or two sizes of insulators not larger than 6 inches in diameter, and these were placed and operated successfully on lines ranging in voltage from 10,000 to 22,500, and so far as the company knows are operating successfully at the present time. The designs then brought out, however, were found later to be entirely inadequate for higher voltages, as all engineers, as well as manufacturers, seemingly had in view, in the early stages of this development, insulators with great creeping surface, failing at the time to take into consideration arcing distance or air space. However, all of this work led up to a very much greater development, and in 1903, the Thomas people issued their first high voltage catalogue covering about thirty designs for voltages ranging from 5,000 to 60,000, although at that time the 60,000 volt lines were not numerous. The requirements since then have created a demand for insulators capable of carrying 100,000 volts for long distance, and commercial insulators to supply this demand have been furnished. At the same time experimental work is being done on insulators capable of higher voltages—even up to 150,000 volts. The great progress which has been made in this line is shown by the fact that the Thomas catalogue of 1903 included only about thirty designs, while at the present time this company have on the market over one hundred distinct types and practically every type has been placed in service.

To go more fully into the subject of manufacture, we believe that the first insulators made for transmission lines were of a solid piece of clay, while the R. Thomas & Sons Co., in their early experimental stages, worked along the lines of making the insulators in separate shells. It is a fact well known in the art of pottery that a thin piece of clay can be moulded and vitrified more satisfactorily and more free from cracks and flaws than a thick piece, and it was for this reason that they worked along these lines. The firing of these shells is a very important factor and detailed uniformity and proper thicknesses were worked out first in order that they would properly withstand the firing, maintain their shape, and retain the proper and uniform thickness to give mechanical strength.

Another important feature that enters into the manufacture of high voltage insulators, is the thorough electrical testing of them in order that all flaws and imperfections may be discovered before they are placed in service. In the early stages of manufacturing, The Thomas Company installed a testing set with a capacity of 60,000 volts. This, however, was found inadequate within a year, and new testing apparatus was installed capable of from 120,000 to 150,000 volts and of about 40 kilowatt capacity. Two years later, the business had grown, and the requirements in the way of tests had become so much greater that it was found necessary to install still a larger testing apparatus, and they, therefore, placed in operation a 200 kilowatt capacity set, capable of from 200,000 to 250,000 volts. With this testing plant, some other interesting features have been brought out, particularly in placing the insulators under severe conditions, such as heavy rain storm

SEPARATE SHELLS OF INSULATORS READY FOR GLAZING.

A CORNER IN THE KILN SHEDS.

tests, etc., to ascertain at what point various types of insulators would arc over or the current jump around from the wire to the supporting pin.

In cut No. 1 is shown an insulator designed by Mr. R. D. Mershon, for use on one of the lines for which he was consulting engineer. This insulator, as shown, was placed in position on a metal pin with one wire through the top groove and around tie wire groove and the other wire fastened to a metal pin at the bottom of the lower petticoat with approximately ¾-in. precipitation of rain on the insulator; a voltage of 100,000 was turned on it and this gradually stepped up to 130,000 volts, when the current arced around from wire to wire, but no injury was done to the insulator.

This same insulator was then placed in position as shown by cut No. 2 on a large metal pin for mechanical test. Heavy pieces of casting were used for this test and smaller pieces of metal added until the weight had reached 4,225 pounds when indications were that the pin would soon bend. While this weight was being sustained by the insulator, as shown by the photograph, current of 160,000 volts was applied. This was for the purpose of ascertaining if any electrical defect was produced by placing the insulator under severe mechanical stress. Nothing occurred to affect the insulator in any manner whatever, although the pin gradually bent until the castings touched the floor at this weight.

This same insulator was then placed in the testing bath and current turned on and raised until it reached about 186,000 volts, when it arced over; this test could be carried no further, as it had reached the arcing point.

FROM THE BABY TO THE GIANT. SHOWING RANGE OF SIZES MANUFACTURED BY THE R. THOMAS & SONS COMPANY.

None of the tests above described affected the insulator in any way.

Cut No. 3 shows an insulator designed for and put in use on the Necaxa plant of Mexico, of which Dr. F. S. Pearson is the consulting engineer. This insulator was put under rain test of three-quarter inch precipitation per minute, and for this test, we are indebted to Mr. C. C. Chesney of the Stanley G. I. Company of Pittsfield, Mass. The test was made in a dark room, and after the insulator had been thoroughly wet with the rain sprayed from various angles a current was turned on and voltage raised until it reached 96,000 volts, when it flashed around from wire to wire.

This insulator also has been given a mechanical test of about 3,000 pounds.

Another very interesting test given on the insulator, shown by cut No. 3 was the following:

1st. Clean and dry;

2nd. With water sprayed on at an angle of 30 to 40 degrees;

3rd. With insulator enveloped in steam from boiler;

4th. With insulator enveloped by steam from salt water.

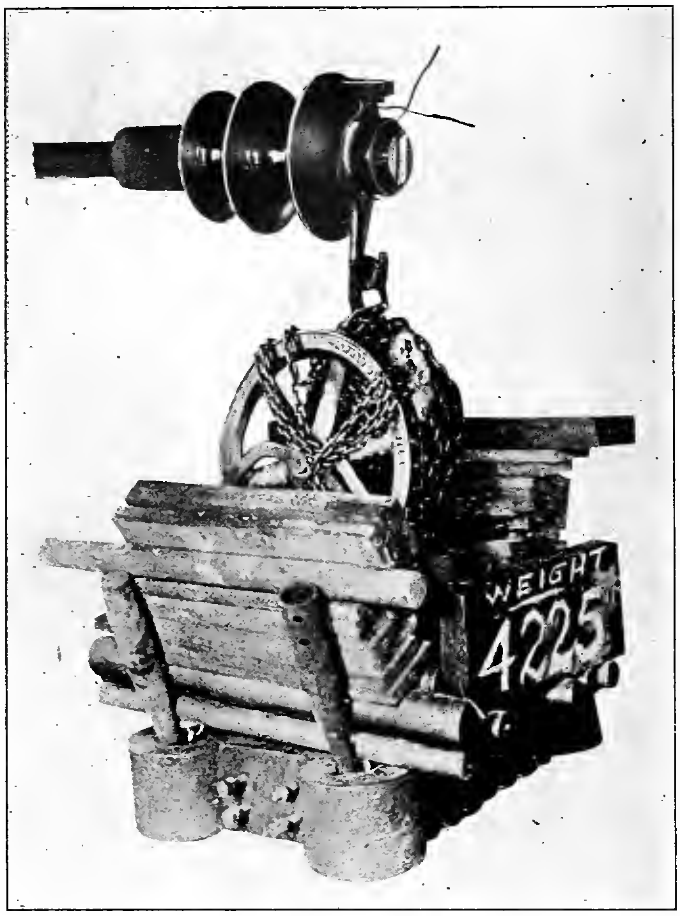
In all of these tests, the cross-arm was 4¾ inches below the bottom petticoat.

CUT NO. 1.
UNDERGOING A PRECIPITATION TEST OF ¾-INCH PER MINUTE, AT 130,000 VOLTS.

Test No. 1. Insulator was put in a position approximating line conditions. Under these conditions, at about 140,000 volts, there was a noticeable play of "static" about the upper part of the head. The voltage was then raised to 180,000, which was as high as they cared to go with the apparatus at hand. Although the insulator at 180,000 volts did not arc over strongly, there was a spitting or crackling spark now and then which appeared to extend from the line wire to the iron pin following the outline of the insulator in its course. Although the voltage could not be raised, it appeared that the insulator was about on the point of arcing over.

Test No. 2. In this test, the water was forced through a nozzle and spread out over the entire insulator, striking it with considerable force at an angle of about thirty-five or forty degrees. It was hardly fine enough to be called a spray and struck the insulator with sufficient force to spatter considerably. Under these conditions, it took 101,000 volts to arc over the insulator.

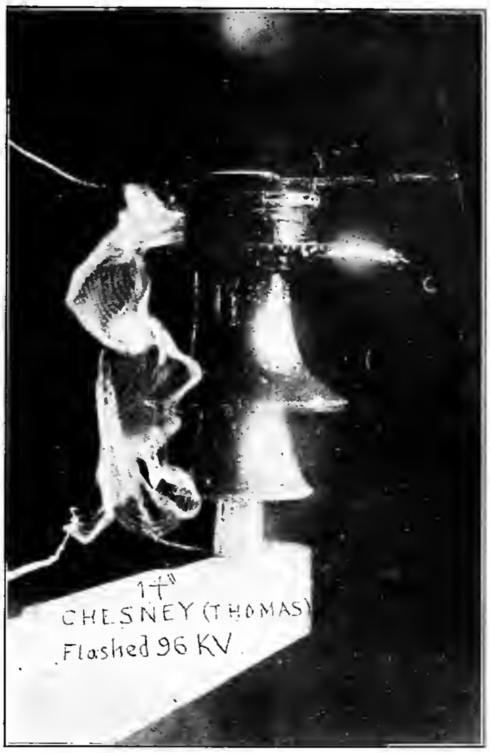
Test No. 3. In this test, the insulator was in an enclosure about 6x7x8 ft. high. There was a door about 6x3 ft. leading into the testing room from the enclosure. Steam was sent into the enclosure from the boilers in the engine room. While the insulator was fully enveloped by the steam, it was



CUT NO. 2.
MECHANICAL TEST.

impossible to get it to arc over at 180,000 volts, but on applying voltage to the insulator within a few seconds after the steam was turned off, about 140,000 volts was all that was necessary to arc it over. However, by waiting still longer before applying the voltage, it took about as high a voltage to arc it over as if the insulator were dry. In about five minutes after the steam was turned off, 180,000 volts was applied to the insulator without arcing it over. At this voltage and under these conditions, there was a play of static all over the insulator from top to bottom. With the insulator enveloped in steam, there was very much crackling at 170,000 volts, but it did not arc over at 180,000 volts. It should be noted here that although the insulator was not visible on account of the steam surrounding it when there was no voltage applied, it could be very clearly seen when the high voltage was applied. This high voltage seemed to clear the fog around the insulator. During this test, the insulator was slightly warm.

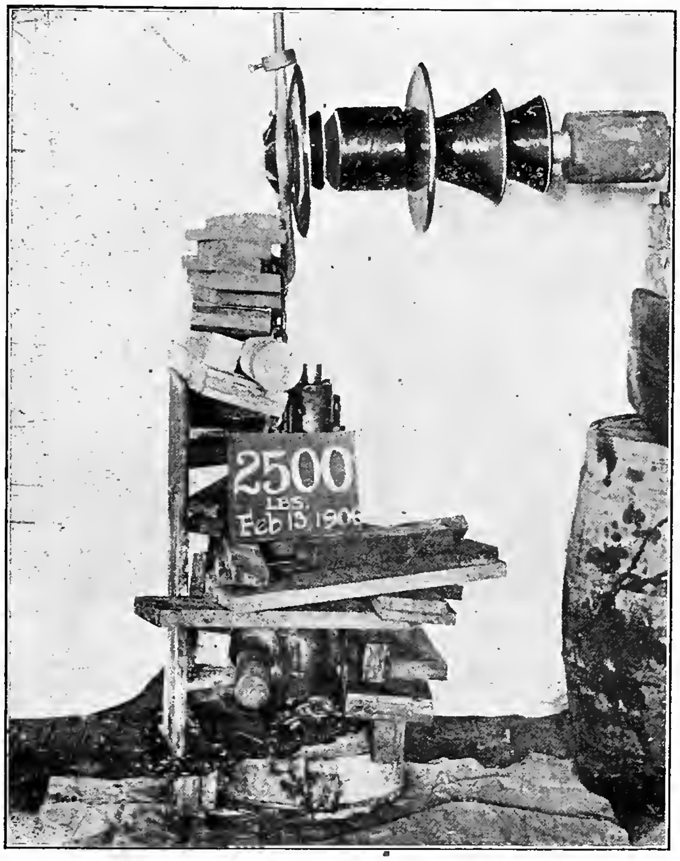
Test No. 4. In this test, with the salt fog, the steam was not forced into the enclosure under pressure as in the previous test. About three feet below the insulator and a little to one side, was placed a galvanized iron wash tub containing about five inches of water and more salt than the water would dissolve. Under this tub was placed a large gas burner in order to boil the water. After the water boiled vigorously for about twenty minutes, the test was made. Owing, probably, to openings around the side of the enclosure, it would not fill up with steam as much as was desired, even when the door was closed. However, the steam floated up around the insulator so that salt was easily detected by placing one's tongue to the insulator before the current was turned on. Around the vertical part of the head of the insulator there was a film of condensed moisture. So much heat was necessary in order to boil the water that the insulator was heated up quite noticeably during the test. Under these conditions, the insulator arced over at about 180,000 volts. This test was conducted



CUT. NO. 3.
UNDERGOING A PRECIPITATION TEST OF ¾-INCH PER MINUTE, AT VOLTAGE OF 96,000.

in the presence of Mr. R. H. Dillon, representative of the Mexican Light & Power Company, New York City.

In the demand which seems to be growing for insulators for extreme high voltages, and in the direction of producing an insulator for working voltage of 125,000 to 150,000, the R. Thomas & Sons Company, as practical potters, realize that it is impracticable to extend the diameter of insulators to much



CUT NO. 4.
MECHANICAL TEST.

greater extent than eighteen or twenty inches, owing to the trouble given in the drying and firing process in keeping them straight. They therefore worked out a new insulator which is shown in Cut 4. When first presented to some of the leading engineers they were inclined to question its mechanical strength. Therefore, as shown by Cut No. 4, a mechanical test was made, using weights as described in Cut No. 2, and after placing 2,500 pounds on the insulator the pin bent to such an extent that they could go to no higher weight.

Later a mechanical test was made in the presence of Mr. F. O. Blackwell and Mr. Cooper, and carried to a point of 3,500 pounds, under which weight the pin bent so much that it came in contact with the center. As yet no accurate data has been secured as to the electrical capabilities of this insulator, although some very high tests have been made on it; but, through the courtesy of Mr. R. D. Rushmore of the General Electric Co., of Schenectady, an elaborate test will be made with their 500,000-volt apparatus, result of which will be given later; preliminary tests made by the manufacturer satisfy them of their ability to produce an insulator for any voltage that may be required.

One point in connection with the Thomas high-transmission insulators which deserves special attention is the perfectly smooth, bright glaze. Electrical engineers all agree that this is a very strong feature and tests have shown that, beyond all contradiction, this glaze is absolutely free of leads or any oxide which would prove a detriment in electrical work. It has also been agreed by electrical engineers that the requirements of high-transmission insulation can only be produced by practical potters of unquestioned experience and ability, and when it is considered that the Thomas family have for three generations devoted their entire time to this industry it is safe to assume they are particularly well qualified for the work. They have been particularly fortunate in this development in receiving the sincere co-operation of leading electrical engineers, both in this country and Canada, and it is largly due to this co-operation that they have been so successful in placing upon the market, not only numerous designs, but designs which have been proven successful under trying conditions.

CUT NO. 5.
TESTED INSULATORS READY FOR PACKING.

COKE AND GAS COMPANY TO EXPAND PLANT AND THEN INSTALL ELECTRICITY.

The directors of the San Francisco Coke and Gas Company decided at a recent meeting to increase the capital stock of the company from $5,000,000 to $10,000,000, and also to increase the bonded indebtedness of the company from $2,500,000 to $7,500,000. President Leopold Michels, of the company, said recently that the directors recommended such action to enable the company to extend its mains, the gas plant, and also to install a plant to manufacture and furnish electricity throughout San Francisco.

He also said, when asked, that the proposed increase in the capital stock of the company and its bonded indebtedness had no connection with the merger contemplated or under negotiation by other companies, and that his company had no connection with any proposed merger. The stockholders of the company will hold a meeting Monday afternoon, March 25th, in the company's office, to vote upon the proposed increase of stock and bonds.

RECEIVER FOR THE NATIONAL WIRE CORPORATION.

A receiver has been appointed for the National Wire Corporation, of New Haven. The liabilities are given as $2,000,000. The plant at New Haven is operated in conjunction with the National Steel and Wire Company, a Maine corporation operating mills in various cities, and which is one of the largest telegraph and telephone wire manufacturing concerns in the country.

Evidently the numerous branches of the H. W. Johns-Manville Company are inadequate to properly supply the demand for its asbestos and magnesia products and electrical devices. On January 1st a branch, consisting of a large retail store, offices and warerooms was opened in New Orleans, in the large three-story building located at the corner of Baronne and Perdido streets. Mr. W. E. Carpenter, formerly local manager of the Western Tube Company, will have charge of this branch.

NEWS NOTES

FINANCIAL.

New York.—The Great Western Power Company of California has filed a mortgage to the Central Trust company of New York as trustee to secure an issue of $25,000,000 five per cent. gold bonds, dated July 1, 1906, and due July 1, 1946, but subject to redemption after five years at 106 and interest. Of this issue $8,500,000 is outstanding. The Great Western Power Company was recently incorporated under the laws of California, with an authorized capital of $25,000,000 as the operating company for the Western Power Company of New Jersey. The latter is a holding company with $18,000,000 authorized capital stock. Edwin Hawley is president of the company.

San Francisco.—The Supreme Court has handed down a decision in the case of the Anaheim Union Water Company and the Santa Ana Valley Irrigation Company against C. B. Fuller, C. H. Fuller, Fred Zucker and F. J. Smith, that embodied two sweeping rulings in the irrigation matter. The case originally arose when the irrigation company protested against the diversion by the defendants of water from the Santa Ana River to lands not riparian to the river. Several questions of interest to farmers and irrigationists throughout the State were passed upon by the court in the decision, notably the matter of watershed rights and the inability of landowners not riparian to claim riparian rights to lands which they acquired from owners who had their holdings along streams from which irrigationists had the right to draw water. The opinion was written by Justice Shaw, and is comprehensive and pertinent in the matters of which it treats. The action originated when the irrigation company complained and sought an injunction against the four defendants, who were located above them on the Santa Ana river. The decision of the court upheld the finding of the Superior Court, which had sustained the plaintiffs in the initial action. In regard to the portion of the decision that settled the rights of riparian landowners as to lands not embraced in the watershed of the stream to which the lands were adjacent, the court said: "Land which is not within the watershed of the river is not riparian thereto and is not entitled as riparian land to the use or benefit of the water from the river, although it may be a part of an entire tract which may extend to the river."

INCORPORATIONS.

Los Angeles—The Las Flores Water Company has been incorporated with a capital stock of $96,000, by J. W. Hughes, D. Galbraith, G. A. Soortwout and Peter Gano.

San Francisco.—The California Traction Company has been incorporated with a capital stock of $100,000, by E. A. Philips, J. J. Srivner, D. B. Richards, J. W. Scott and G. E. Philips.

Globe, Ariz.—The Globe Electric Gas and Water Company has been incorporated with a capital of $750,000, by C. N. Bassett, B. A. Nebeker, A. W. McPherson and others. The principal place of business is at Globe, and an office will be kept in Los Angeles.

Chihuahua, Mex.—The Cia Agricola de Fuerza Electrica del Rio Conchos is the name of a corporation formed in Mexico City, with a capital of $10,000,000, to take over the electric power and irrigation enterprise about 22 miles from Santa Rosalia on the Conchos River. It means the distribution of power to this city and Santa Eulalia and to Jimenez and Parral. A great dam will be built to form a lake covering thirty square miles. The local street car company will get its power for the proposed line here. A more complete description of the Conchos River enterprises will soon be published.

ILLUMINATION.

San Francisco.—A contract has been made between the San Francisco Coke and Gas Company and the Stanislaus Power Company to undertake to supply the people of San Francisco with electric light and power as well as gas. The following announcement has been published by the San Francisco Coke and Gas Company: "The public having by their patronage approved our principles of supplying the best of gas at reasonable rates, we have determined to enter the field of supplying the public with electricity. With this end in view we will immediately commence the construction of an auxiliary power plant, utilizing for that purpose part of the property now used as a gas plant at North Beach, and have entered into an advantageous agreement with the Stanislaus Power Company for the exclusive use of its power as soon as its transmission plant is built. The plant to be constructed by us will be ready early in the fall. Pursuing the same methods as have made our gas business so great a success, it will be our aim to give the best service at most reasonable rates. We therefore request all users of electricity who intend to make a change in their supply to communicate with the undersigned, stating the average amount of electricity used by them, and the price paid. It is the intention of the undersigned in the beginning to construct conduits and lines where the demand is greatest and gradually cover the entire city. We advise you, in your interest, not to make any long-time contracts with other companies, until you have conferred with our representatives.

San Francisco.—Fire destroyed the Rio Vista Light & Power plant at Rio Vista a few days ago, causing a loss of $10,000.

Los Angeles.—Huntington Park citizens will hold a mass meeting to decide on an issue of $15,000 bonds for the construction and equipment of an electric lighting plant.

Los Angeles.—Property owners and business men on Fourth street, from Main to Hill, have presented a petition to the Council for street lighting, which was referred to the Board of Public Works.

Lakeport, Cal.—The Board of Trustees at its next meeting will take up the matter of selling a franchise to the Lake County Electric Light and Power Company.

ENGINEERING.

Applegate, Ore.—Bids will be received by Geo. Hoffman, secretary of the Thompson Creek Irrigating association, until Feb. 1st, for the construction of a ditch from the O'Brien to Sturgin Fork of Applegate.

Echo, Ore.—The 70-ton steam shovel and four narrow gauge engines which will be used in the construction of the reservoir at the big dam on the Umatilla project and which are being moved from Hermiston to the dam site five miles distant, are now within a mile of their destination.

Great Falls, Mont.—The first unit of the Sun river irrigation project will soon be advertised and it is expected that bids will be taken about March 1st.

Lewiston, Ida.—The Waha-Lewiston Land & Irrigation Company will place surveyors in the field at once.

Proser, Wn.—One of the largest mortgages ever given was filed for record by the Benton County Abstract & Title company. It is given by the Hanford Irrigation & Power Company to the Washington Trust Company of Seattle and is for $300,000. It covers 40,000 acres of land, which will be irrigated by a pumping plant being put in at Priest rapids and also the electric power plant of the company.

Portland.—The legislature will be called upon to appropriate $50,000 for co-operation with the government in topograph mapping the state.

TRANSPORTATION.

San Francisco.—An agreement has been reached between the promoters of the Central California Traction Company and the projectors of the new electric line to connect Sacramento and Lake Tahoe, whereby the latter company will have the use of the former's tracks from Brighton to Sacramento, including the terminal of the traction concern, which will be reached by a private right of way. The Tahoe road will follow the banks of the American River from Folsom to Brighton, where it will connect with the traction company's line running from Stockton through Lodi, Elk Grove and Florin. As each of the companies is expected to maintain an hourly service, the combination of interest will mean two cars every hour from Sacramento to Brighton.

Los Angeles.—Sealed bids will be received by the county clerk for a franchise for an electric railroad upon certain public highways in Los Angeles county up to Feb. 11th. Each bid must be accompanied by a certified check of the full amount of bid. Railroad will commence at the intersection of E. Orange Grove Ave., with the easterly boundary of Pasadena, running along East Orange Grove to Allen Avenue.

Los Angeles.—Sealed bids will be received by the county clerk for a franchise for railroad to run on certain public highways in Los Angeles county up to 2 p. m. of Feb. 11th. Railroad will commence at intersection of Eagle Rock Avenue with northerly boundary of Los Angeles running along Eagle Rock to Anandale View Terrace Tract.

Los Angeles.—Sealed bids will be received by the city clerk for a franchise for a double track or four tracks of electric railroad in Los Angeles up to Feb. 11th. Railroad to run on Vermont Avenue, Trolo, Jasmine, King streets, Harvard Boulevard, Western Avenue, Manhattan Place, St. Andrews Place, Gramercy Place, GaGrnier Place adn Wilton Place.

Los Angeles.—Orders have been issued by H. E. Huntington officials to begin work at once on the line to be constructed on Seventh street.

Placentia.—Mr. Pillsbury, manager for H. E. Huntington, assures the residents that an electric road will be built through Placentia south as soon as the road from La Habra west is completed.

Los Angeles.—In Glendale several properties have been bonded to secure right of way for the Los Angeles electric line, that is to run from Pasadena and Eagle Rock Valley to Santa Monica. This line is to pass through Glendale, Ivanhoe and Hollywood, and probably touch the new town of Beverly and thence on to the Ocean Front.

WATERWORKS.

San Francisco.—The building of a reservoir near the drive in Golden Gate Park between Strawberry Hill and the ocean, was taken up at a meeting of the Park Commission this week and favorably discussed, but definite action was postponed pending an investigation as to whether the expenditure would be justified. Superintendent McLaren reported that the proposed reservoir would cost $9,513.

San Francisco.—The Mokelumne River and Blue Lakes project of water supply for San Francisco has been offered to the Supervisors by the Sierra Nevada Water & Power Company, through its attorney, John S. Partridge, for $3,000,000. The offer includes the entire rights and plant of the company. Last fall the company offered the property for $5,000,000.

San Bernardino.—The Arrowhead Reservoir and Power Company's incline in Waterman Canyon, lifting the canyon to the Skyland cliff, is to be operated by electricity immediately. The power is to be obtained from the Edison Company, which already has a power line in Waterman Canyon as far as the old Waterman barn, where the line bends to the Arrowhead Hotel. From the former point the Arrowhead Reservoir and Power Company will take it and carry the line up to the foot of the incline, which is at the head of the canyon, just across from the foot of the switchback grade. Deeds for the power line that have been filed do not include the right of way for a trolley line, but it is believed that such is contemplated, and will be taken up with property owners. The tunnel project calls for 335 feet in length 7x8 in size.

San Francisco.—The Stanislaus Electric Power Company, through its working company, The Union Construction Company, has just closed a contract for an electric power transmission scheme of importance to California industries. The site of the proposed plant is at Vallecito, on the Stanislaus River near Angels Camp and the scheme contemplates the utilization of the waters of Stanislaus River, transmitting the power electrically to San Francisco, and incidentally tapping the southern mines and the upper San Joaquin Valley. From a hydraulic standpoint the proposition is of particular interest, as it involves the largest power units that have ever been used for impulse wheels. The operating head is 1400 feet, equivalent to a pressure of 608 pounds per square inch. The present equipment calls for three 6700 kilowatt 400 revolutions per minute. General Electric generators, each of which will be driven by a Pelton water-wheel unit of 12,000 horsepower capacity. Not only are the individual units larger than heretofore attempted, but the capacity of the station in excess of 36,000 horsepower is greater than any existing at the present time. The only instance approaching this in impulse water-wheel practice is the plant of the Puget Sound Power Company, at Electron, Wash., in which are installed four Pelton wheel units, each driving a 3250 kilowatt generator with a combined maximum capacity for the station of 30,000 horsepower. The units for the Stanislaus plant will be of the "double over-hung" construction, characteristic of Pelton design for high power wheels, each overhanging the opposite end of a heavy shaft which carries the motor of the generator in the center. The equipment will represent the highest development in hydro-electric transmission, and the installation is looked forward to with the greatest interest by engineers generally.

Dawson, Y. T.—The preliminary survey for the power line of the Fuller Grant line between Coal Creek and this place is being run by Garrett Tyrell and party. The company plans to install its large power plant at Coal Creek next year.

OIL.

Bakersfield.—The Recruit Oil Company, which is another name for the Associated, and which is holding thousands of acres of supposed oil land in the Elkhorn Valley, had 50 men on its claims on January 1st to prevent any "jumping." These claims, embracing a large part of the valley, for the most part, had no assessment work done on them, and were consequently subject to relocation, hence the men to protect the company's interest. The Union Oil Company also had a force of men in the same locality, it and the Recruit having pretty much the whole territory located. On these lands there is no mineral in evidence unless it be gypsum here and there, and it is reported that a government agent has recently visited the west side country investigating the claim of gypsum discovery, upon which so much land is held.

San Francisco.—The Union Oil Company is preparing to put in larger boilers and to enlarge its pumping plant at Norwalk.

Phoenix, Ariz.—The sandstone rocks northeast of this place have been found to carry paraffine oil and test wells will be bored. The field is eight miles from here, and higher than the city, so that pumping to the two railroads would be easy.

San Francisco.—The capital stock of the Bull's Head Oil Works has been increased from $1,000,000 to $5,000,000, that is from 10,000 shares of stock, par value, to 50,000 shares.

ELECTRIC RAILWAYS.

Sacramento, Cal.—There has been filed in the office of the county recorder a deed by W. H. Basler and wife to the Northern Realty Company of the 18 12-100 acre tract of land on the east bank of the American River, near to 19th Street if extended. This means that the long and bitter litigation between Mr. Basler and the Northern Electric Company over the condemnation of the tract is at an end. On the 9th of November, 1906, the jury gave a verdict for Basler for $7,000; with this he was dissatisfied, claiming that $12,000 or $13,000 would only be fair compensation. No sooner was the verdict entered than Basler moved to suspend the entry of judgment on the ground that the Northern Electric Company is not a California corporation and that under its Nevada charter it has not the power to build and operate railroads in this State, and hence not the right to call upon the courts to exercise the power of eminent domain in its behalf. Now comes the deed of Basler to the Northern Realty Company, which closes the whole business involved. Under the terms of settlement Basler receives $8,000 cash and reserves the right to remove from the tract all the timber and the fencing.

San Francisco, Cal.—The Board of Supervisors has passed to print an ordinance granting to the United Railroads a franchise for the construction and operation of an overhead trolley system on Sixteenth Street, from Kansas to Seventh. The corporation named was the only bidder for the franchise, which is to run for 25 years, and in its bid agreed to comply with the charter requirements on franchises, which include the payment to the city of a fixed percentage of the gross receipts of the road. The road will tap the new wholesale district near the Potrero and the sale of the franchise was petitioned for by many wholesale merchants and laboring men. It is understood that work on the road will begin at once, the Western Pacific Company having agreed to withdraw injunction proceedings as it will not interfere with the proposed tracks on Sixteenth Street, for which it has petitioned for permits, to connect with its main line. The judiciary committee was given one week's time to report on the petition of the Presidio and Ferries Railway Company for an extension of 90 days' time to complete the work of converting the Union street cable road into an electric system.

Chico, Cal.—The Northern Electric Company has made application before the Board of Supervisors for two franchises in the county. One application is for a franchise to construct a spur freight line around the eastern limits of Chico. The other petition asks for a route west from the intersection of Oak and Fifth Streets on the west side of the tract. This is for the line from Chico to Hamilton City. The city 1,600 feet to where the route enters the Northgraves petitions ask for a 50-year franchise, for single or double tracks and the right to haul both passengers and freight traffic with steam, electricity or compressed air motive power.

San Francisco, Cal.—The Northern Electric Company has ordered 200 flat cars from the East, and part of them are en route now. They will be used between Chico, Oroville, Marysville and Sacramento. Their capacity is 80,000 pounds, and they are of modern type.

Columbia City, Wash.—The Seattle, Renton & Southern has applied for a franchise extending from its line on Rainier Boulevard up Ferdinand to Noble, from Noble to Holmes and from Holmes back to the boulevard. The Seattle Electric Co. has applied for franchise to lay tracks down 37th Ave. to America St. This is the extension of the Rainier Heights line.

Davenport, Wash.—The county commissioners renewed the franchise of the Big Ben Transit Co. from this place to Crystal City, on the Spokane River.

Portland, Ore.—At the meeting of the East Side Business Men's Club a movement was started to get the Portland Railway, Light & Power Co. to provide suitable waiting rooms for passengers at the principal transfer points on the East Side.

Spokane, Wash.—The Inland Empire has announced that it will extend its line from Waverly to Pullman and Moscow, thence south to Lewiston, Ida.

Seattle, Wash.—Councilman Crichton has called a mass meeting of the citizens of Queen Anne Hill to take up the matter of car line extension on top of the hill.

Tacoma, Wash.—The Tacoma Ry. & Power Co. is erecting passenger stations at various points on the line between South Tacoma and the terminus. Construction work is also in progress upon the big loop at the end of the line.

Boise, Ida.—During the present year the Short Line will construct a line from Armsted on the Utah Northern to the Gilmore section in Lemhi county, a distance of 70 miles.

Cheyenne, Wyo.—It is reported that the Burlington has awarded contract to Guthrie Bros. for the construction of a road through the Twelve-Mile Canyon. Estimated cost, $1,000,000 a mile.

Juneau, Alaska—The Perseverence Mining Co. will immediately commence the construction of a narrow-gauge railroad from this place to Silver Bow Basin.

Kiona, Wash.—J. S. Washtock, a sub-contractor on the North Coast Ry., has established a camp north of town.

Kiona, Wash.—Seventeen N. P. surveyors under W. D. Clegg arrived here to make a new survey to straighten the track on each side of this place.

Missoula, Mont.—Winston Bros., the contractors in charge of the N. P. construction work in Western Montana, will build those stretches of the Milwaukee road extending from Durant to Garrison, a distance of 36 miles, and from this place to Saltese, a distance of 100 miles. Winston Bros. will sub-let nearly all the work.

Lewiston, Ida.—Naylor & Norlin, of this city, who have a contract on the Milwaukee road, are establishing a camp in Douglass county on Beaver creek.

Pendleton, Ore.—The Pacific Coast Construction Co. has completed one-third of the grading for the Pilot Rock Ry. which is being extended from this place to Pilot Rock.

Portland, Ore.—It is reported that contracts have been let for the Nation-Klamath Falls line of the Southern Pacific.

Seattle, Wash.—One of the most elaborate systems of railway terminals on the Coast has just been announced by the Union Pacific. They include switching and terminal tracks, dump yard, round house, machine shops, repair shops, and turntables. They will be located in Seattle, Georgetown and along the line of the interurban tracks, embracing ground 6,000 feet long and 700 feet wide, with a capacity of 4,472 40-foot freight cars, in addition to the buildings that will be erected on the grounds.

TRANSMISSION.

Kingman, Ariz.—Superintendent Porter of the Gold Road M. & E. Company, has left for Los Angeles, where he will confer with the directors of his company regarding the installation of a power plant at Kingman. The power will be transmitted to Gold Road and the machinery of the big mill hoisters and outside power will be electric. The capacity of the mill will be increased.

San Francisco.—Samuel L. Napthaly, chief engineer of maintenance and operation of the San Francisco Coke and Gas Company, is to sever his connections with the corporation, to accept a position with the Fleischhacker interests. On the 1st of March Mr. Napthaly will resign the position he has held for many years to become manager of the Truckee River General Electric Company and the American River Electric Company, both interests being controlled by the Fleischhackers.

The JOURNAL OF ELECTRICITY POWER AND GAS

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VOLUME XVIII. SAN FRANCISCO, CAL., FEBUARY 2, 1907 No. 5

The Electric Light, Power and Heating System of the University of California.

The University Campus at Berkeley, with its numerous buildings and a transient day population of about four thousand people, is in many respects not unlike the down-town district of a large city. The problem of adequately providing heat, light and ventilation to the many auditoriums and lecture halls, the private offices, the experimental, testing and students' laboratories, and the gymnasium, is an exceedingly complex one on account of the widely different character of the service required.

About three years ago the Board of Regents of the University took definite steps toward securing the installation of a heating system which would more satisfactorily, as well as more economically, keep the various buildings supplied with warm and pure air. At the same time contracts were let for the equipment of a power plant to provide the large amount of electrical energy required for lighting and power purposes. The University of California is just now in a period of rapid growth, and all improvements of a permanent nature must be designed with strict regard to the plans of the "Greater University."

CALIFORNIA HALL—THE ADMINISTRATION BUILDING.G

The Heating System.

Some idea of the magnitude of the heating system being installed may be obtained from the fact that when the work

already contracted for is completed, about two miles of piping will have been laid. Of this about three-quarters is already under ground, and carrying steam to several buildings.

Two common systems of heating are employed. In the Harmon Gymnasium, the Hearst Memorial Mining Building and California Hall—the last two named being magnificent white granite buildings of the most modern construction—the forced-blast system of heating and ventilating is used. In this system a motor-driven fan or blower, usually located in the basement, draws in cold, pure air from the outside, and causes it to pass over and through coils through which steam is circulating. The air becomes warmed and is forced through distributing ducts into the various rooms through registers located in the upper part of the walls. The impure air, which contains carbon dioxide and other undesirable gases, is forced out through openings placed in the lower part of the walls of each room and delivered through vents to the outside.

THE HEARST MINING BUILDING.

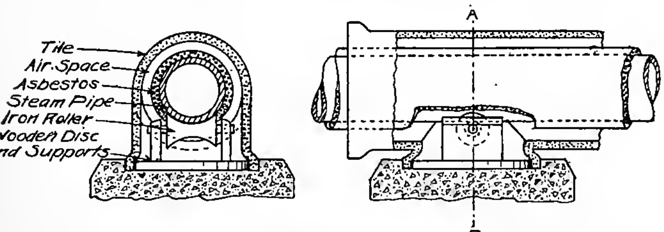
The low-pressure gravity system, in which radiators are employed, is already in operation in the Library, East Hall, Hearst Hall, Spreckels Physiological Laboratory, and the Student's Infirmary. The work of equipping the Faculty Club, Senior Hall, the Chemistry Building and the Agricultural Building, is already under way.

On the southern edge of the Campus, just above the Telegraph Avenue entrance to the grounds, is located a red brick, fire-proof building which houses the central heat, light and power plant of the University. The site has been so selected that as the needs of the various departments are increased, this building can be enlarged to house the extra equipment.

At this plant steam will be generated at 150 pounds pressure and passed through a reducing valve into the steam-heating mains at a pressure of about 25 pounds per square inch. A high-pressure line is being laid at present to the Hearst Memorial Mining Building, with a branch line to the Mechanical and Electrical Engineer Building, situated directly west of it. High-pressure steam will be used in the former building to drive air compressors and for experimental purposes. In the Mechanical and Electrical Engineering Building is the present electric power plant of the University, and the object of inter-connecting the two buildings with the central power plant by a high-pressure steam line, is to provide against interruption of the service in cases of emergency. Thus both buildings may receive steam from the central plant, or the Mining Building can receive steam through the same pipes from the boilers in the Mechanical and Electrical Engineering Building.

The steam mains and the return pipes are laid side by side, and where possible at a uniform upward grade from the heating plant of about one inch in ten feet. The pipes are of wrought iron, and are laid in a high grade of air-cell asbestos pipe covering one inch thick. The canvas is painted with P. & B. paint, which makes the joints absolutely tight. The whole is enclosed in ordinary salt-glazed, vitrified tiling with an air space of one inch between the canvas covering and the inner surface of the tiles.

Ample provision for expansion in the piping is one of the most important factors to be considered in the design of a steam-heating system. A novel method of supporting the pipes underground to allow creeping during changes in temperature is used in connection with this system, and promises to give excellent results. As will be seen in the accompanying sketch, the bare under-surface of the pipe rests on an iron roller which is supported on wooden uprights fastened to a circular disc. This is set in the branch opening of an joint painted to make it tight. The whole rests on a bed of ordinary Tee tile and the disc is firmly fastened in and the



SKETCH SHOWING METHOD OF SUPPORTING THE STEAM PIPE.

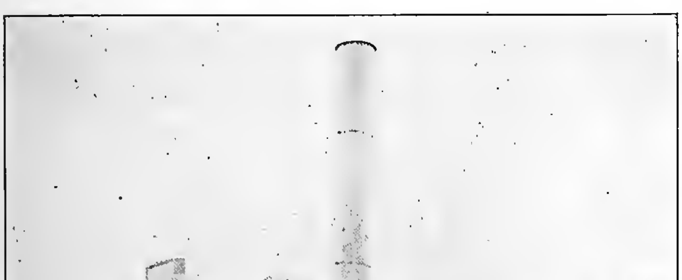
cement. These supports are placed at intervals of about 20 feet, and allow a longitudinal motion of the pipe with comparatively little friction.

In several of the concrete manholes, where the pipes branch, the branching fittings are laid in concrete with their upper surfaces just exposed. The rigid abutment thus formed causes the expansion to be entirely in one direction. The changes in length are taken care of by unbalanced expansion joints placed in other manholes. The pipes on entering a building, are usually suspended from the cross beams of the floor above by short chains, to maintain the elasticity of the system.

The steam pipes, on leaving the plant, are either six or seven inches in diameter, but are reduced in size to, in some cases, a diameter of two inches, according to the calculated amount of steam to be supplied. The return pipes vary in diameter from three to one and one-fourth inches.

In the several manholes are placed gate valves, a combined separator and steam trap for the condensed steam, and a thermostat with a thermometer to prevent the flow of steam in the return pipes above a certain temperature.

In such buildings as are heated by the low-pressure gravity system, the steam enters the building at a pressure of about 25 pounds and is passed successively through a stop-valve, a combined separator and steam-trap, another stop-valve, a reducing valve, a safety valve and a thermostat. The steam loses its water of condensation in the separator and passes through the reducing valve at a pressure of one pound or less, at which it is distributed throughout the building. The safety valves are set to blow off at about ten pounds and the thermostats insure a reasonable efficiency of the system by preventing steam from passing into the return pipes until it has lost a considerable amount of heat. Pressure gauges and thermometers are used in connection with the above apparatus to supply such information as is required for good regulation.



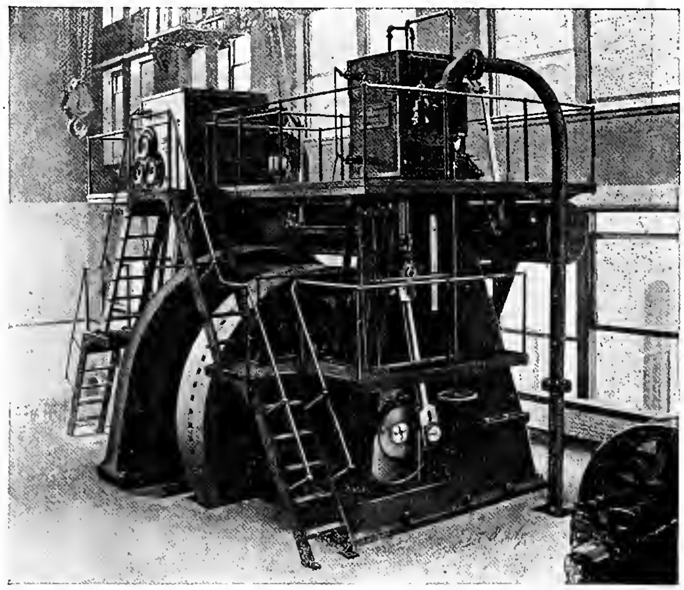
CENTRAL POWER AND HEATING STATION.

Some steam is necessarily condensed in transmitting it underground for distances of several hundred feet. This necessitates the use of separators and steam traps. In buildings all taps are taken off at a vertical angle of 45 degrees, sloping upwards, to prevent water in the distributing main from passing into the branch pipes along with the steam.

In the construction of this system, only the best quality of material has been used, and the highly satisfactory results already obtained more than justify the additional expense.

Several hundred shower baths are in use in the Harmon Gymnasium and in Hearst Hall, which is the women's gymnasium. Water for these is heated indirectly in long cylindrical steel tanks by passing steam from the main supply through pipes set longitudinally within the tanks.

The Students' Infirmary will be heated by the low pressure gravity system of indirect radiation. Zenith flue box-base radiators will be installed in front of openings in the walls communicating with a source of pure air. The incoming air in circulating around the heating coils of the radiators, will become warmed before passing into the rooms.



McINTOSH-SEYMOUR CROSS COMPOUND ENGINE IN CENTRAL POWER STATION.

Pure water for hospital use will be obtained by means of an automatic filter of novel construction to be operated on the steam line of the building. It is estimated that about 300 gallons of distilled water, both hot and cold, will be available during a period of twenty-four hours.

In California Hall and the Harmon Gymnasium, where the combined system of heating and ventilating has been in use for some time, the fans are driven by induction motors operating at 220 volts. The fan in California Hall is 4 feet wide and 8 feet in diameter.

Power Plant Equipment.

The boiler equipment of the central power plant consists at present of three Babcock and Wilcox patent safety water-tube boilers designed for a maximum pressure of 200 pounds. Each boiler is supplied with a super-heater, and has 1088 square feet of heating surface and 90 square feet of grate surface. The maximum capacity of each is about 218 horsepower. Two boilers are operated in battery and the other singly. Floor space has been allowed beside the latter for the installation of another boiler of similar type as soon as additional steam is required.

The furnaces are oil burning, being equipped with P. and M. burners. The auxiliary equipment includes one Hoppes 260-horsepower live steam purifier, two Snow duplex steam pumps, $5\frac{1}{4}$ by $3\frac{1}{2}$ by 5 inches, and two duplex oil pumps of the same make, 3 by 2 by 3 inches. The above apparatus is located on the ground floor. In the basement, connected

to the return pipes of the steam heating line, is a duplex Worthington suction pump, 6 by 8½ by 6 inches. The suction is 6 inches, and the discharge 6 inches. Normally a vacuum of 20 inches is maintained.

For the generation of electric power a McIntosh and Seymour vertical, cross compound engine of the side-crank type has been installed. This is arranged for direct connection to a 200-kilowatt, 60-cycle, 2-phase alternator generating at 2,200 volts at 125 revolutions per minute. The capacity of the engine working at a gauge pressure of 150 pounds with a normal superheat of about 100 degrees, is about 350 horsepower. The cylinder dimensions are 12 and 26 inches by a 30-inch stroke. The engine is non-condensing, and may exhaust either directly into the atmosphere, or into the steam pipes of the heating system. In connection with the governor, a speed changing device is operated by an electric motor using exciting current. This allows a speed variation of four or five revolutions per minute for bringing separately-driven units into synchronism. This device may also be used for dividing the load between engines. Besides the above, dash pots are employed to prevent the oscillation of currents between two or more alternators operating in parallel.

Provision has been made for the installation of another similar engine-driven unit to be installed later.

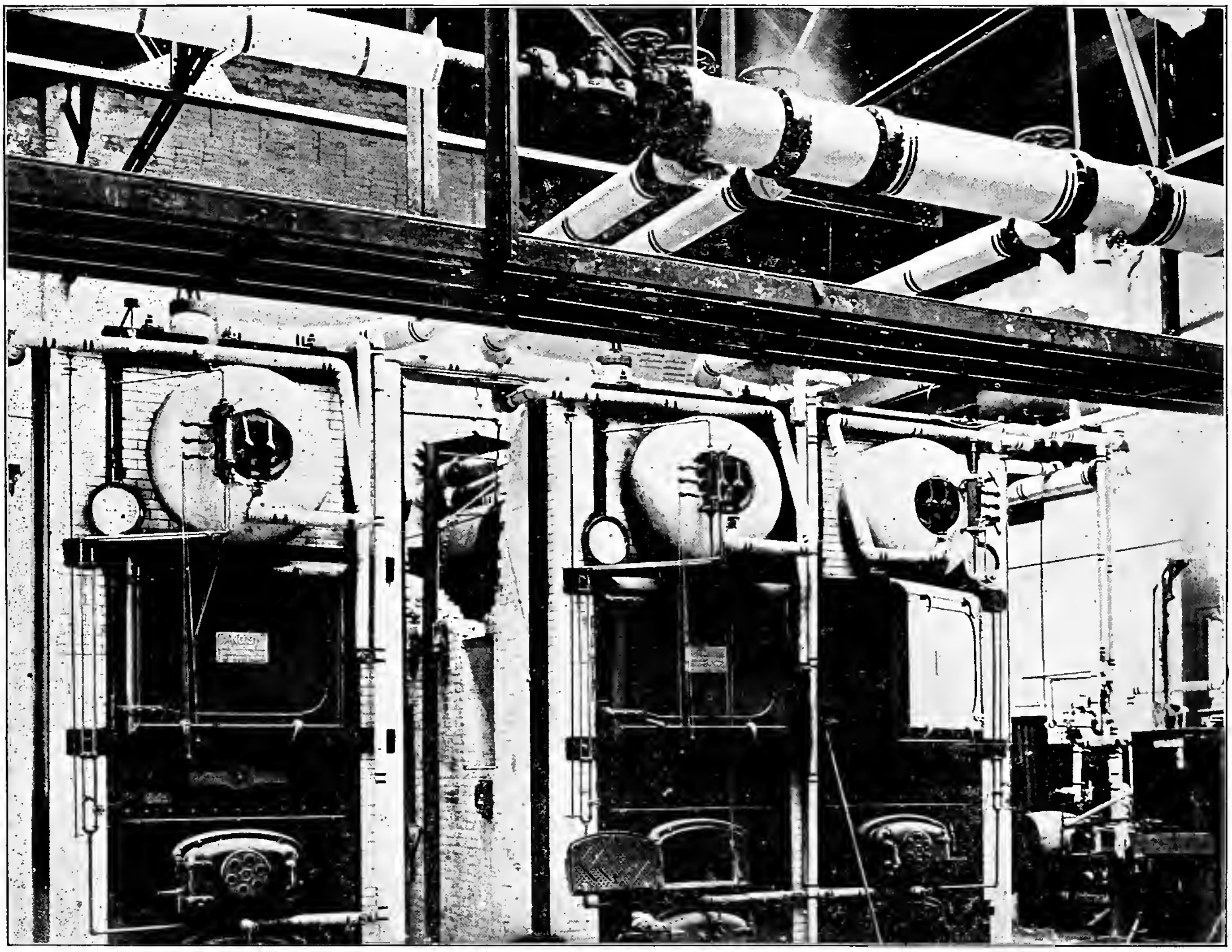
Fuel oil for the furnaces is stored in a steel tank set in a pit just outside of the building. It can hold about 12,500 gallons of oil, which is about the capacity of the largest tank cars in use in California.

The Power and Lighting System.

Besides having available the electrical power to be generated at the central power plant, the University has arranged to use electrical energy from the transmission line of the California Gas and Electric Corporation. In order to improve the load factor on its local line during the usual daily periods of light load, the company has agreed to furnish electrical power at a rate much lower than that at which it can be generated on the grounds. It is understood, however, that when the power demand on the company's line is heavy, the University plant will carry its own load.

Power will be received from the Temescal power house at 4,000 volts, three-phase, and transformed to 2,000 volts, two-phase by two 75-kilowatt oil-cooled transformers to be located in the Mechanical and Electrical Engineering Building. The power will be distributed to the various buildings through an underground conduit system, which will do away with the unsightly pole line at present on the campus. By means of transformers placed either in the basements or near each building, the voltage will be stepped down to that required for lighting and other purposes.

A considerable amount of direct current at 220 and 110 volts will be used in operating the elevators in California Hall and the Hearst Mining Building, and for driving the variable speed motors in the printing office. To supply this a 50-horsepower induction motor will be installed in the Mechanical and Electrical Engineering Building to drive two 25-kilowatt, 125-volt generators mounted on each end of the motor shaft.



BABCOCK & WILCOX BOILERS, SHOWING STEAM CONNECTIONS.

The reason why this machinery, as well as the large transformers, are to be located in the Mechanical and Electrical Engineering Building rather than in the central power plant, is that the greater amount of the power will be consumed in the vicinity of this building; besides, the power company prefers to run its line in on this side of the campus rather than on the side on which the power plant is located.

At present the University gets its electrical energy for power and light from two sources. A single-phase line of the California Gas and Electric Corporation enters the Mechanics Building at 2,200 volts, and is transformed down to 1,100 volts for distribution from the switch-board in the engine room of the same building.

Here are in operation a Westinghouse 45-kilowatt, 125-volt, direct-current generator and a 40-kilowatt, two or three-phase Westinghouse alternator. Both of these units are indirectly belted to a non-condensing Ball engine rated at 100 I. H. P., and of cylinder dimensions, 12 by 12 inches. A General Electric constant-current transformer of 21-kilowatt capacity and of primary voltage equal to 1,100, supplies current for the arc lamps used in lighting the grounds.

In the boiler room, adjoining the engine room, are two Babcock and Wilcox water-tube boilers set in battery. The larger has a capacity of about 100 horsepower, and the smaller about 75 horsepower. The auxiliary apparatus includes purifier, heater, steam and oil pumps. Before the present coal famine coal was used for fuel, but the furnaces are now burning oil.

A 12,500-gallon fuel-oil tank similar to the one installed at the central plant, is now being installed. Two smaller tanks are now in use. These will be interconnected with the large tank by pipes and valves so that three grades of fuel-oil can be available at one time for testing purposes. This will be a valuable addition to the experimental equipment of the department.

In one of the electrical testing laboratories is a Westinghouse 40-kilowatt, 1,100 volt, two-phase alternator belted to a 50-horsepower, straight-line engine of dimensions 9 by 12 inches. This generator is used principally for supplying current for the testing laboratories, although it is frequently made to serve on the lighting circuit.

Up to the present time the generators in this building have been supplying the greater part of the electrical energy consumed in the various buildings and on the grounds. But as soon as the generator in the central power plant has been installed, this entire equipment will be used more especially to supply the requirements of the departments of mechanical and electrical engineering.

PROOF THAT TELEPHONE INSTRUMENT CONTAINED DEADLY CHARGE OF ELECTRICITY CASTS BURDEN ON COMPANY OF SHOWING THAT IT WAS NOT NEGLIGENT.

A case from Pennsylvania recently decided by the highest court of that State contains an important ruling on the above proposition. The facts were that one Delahunt's telephone had in some manner become out of order and had remained so for some days. He had received a notice from the manager of the company that the telephone would be repaired as soon as possible, and was waiting until he could use it again. One evening he heard a sharp clicking of the instrument, and thinking that it had been repaired, went over to it, and with both hands lifted the receiver from the hook, when suddenly there was a flash, and Delahunt fell lifeless. The above proof constituted practically all of the plaintiff's case. No testimony was offered by the defense, thus raising the question whether under such a state of facts the defendant is required to prove that it was not responsible for the accident; in other words, whether under such a showing the presumption is that the company was or was not at fault. This is a question of great importance, as it can readily be seen that the burden of proof in negligence cases of this sort will be shifted one way or the other, depending on the conclusion given. The following quotation from the decision of Justice Brown, who wrote the opinion, is sufficiently clear to need no further comment:

"Electricity is the agent by which telephones become the means of communication from one point to another, and it may be conceded, as the appellant contends, that the current needed for their use is not a dangerous one. In this case it may be still further conceded that the current with which the deceased came in contact did not come from the exchange of the defendant company; but at the same time it cannot be questioned that it came over one of its wires leading to the telephone of one of its patrons. Though the wire was intended to conduct only a harmless current, the defendant was bound to know that it could become the conductor of a deadly one, and that such a current would pass over it if it was not properly insulated, and should come in contact with a wire heavily charged. Its duty to its patrons was to exercise at all times the highest degree of care and vigilance to protect them from a dangerous electric current over its wires from any source. This is the implied undertaking of every telephone company, and * * * when there is an accident which in itself affords reasonable evidence of negligence, it must show why it should be relieved from liability."

At the trial the company asked that it be relieved from liability on the ground that the deceased having admitted that he heard the click of the instrument, had a warning of danger. The Supreme Court said that this position might be tenable if the current ordinarily carried over a telephone wire were dangerous, but since the fact is otherwise, Delahunt did nothing that in law could be considered contributory negligence, and that the defendant could not escape responsibility on this ground. A verdict of ten thousand one hundred seventy-five dollars and eighty-nine cents ($10,175.89) was therefore affirmed. While there is nothing in the case tending to establish that the company was in any way at fault its inability or failure to prove affirmatively that it was not, cast upon it the responsibility of paying this enormous verdict.

Delahunt v. United Telephone & Telegraph Company, 64 Atlantic 515.

An efficient protector at the instrument would have saved the company over $10,000.

ELECTRICITY IN INDIA.

In a report to his Government by the United States Consul-General in Calcutta there are indications of openings in parts of India which it behooves manufacturers connected with the electrical industry to keep in view. The consul advises builders of electrical roads and of electric cars and appliances to send representatives to the State of Mysore, and, in addition to pointing out the most direct routes by which to reach that State, he mentions the most important cities which should be made headquarters—viz., Bangalore and Mysore. He reports that the Mysore Government have recently passed a tramway (electrical road) regulation which extends to the whole State of Mysore, although primarily conceived to meet the convenience of the Mysore Manganese Company. A project is on foot to build an electric line connecting the civil and military station with the old Bangalore City line, and other extensions from that point. The whole system can be furnished with electricity from the Cauvery Falls, a head of water quite sufficient for not only the tramways, but for lighting purposes and mills and factories. It is to be hoped that British electrical engineers and manufacturers of electrical goods will not allow these opportunities to escape them and pass into American hands, and that they will thoroughly investigate the openings that have occurred in Mysore State.

THE WIRING OF SMALL CENTRAL STATIONS.*

The Work and Responsibility of the Erecting Engineer.

The installing of cables, small wiring and accessories in central stations and isolated plants of small and medium size, is too frequently given secondary consideration. The operation of any electric plant unquestionably depends largely upon this factor, and it is remarkable how some plants are operated for long periods under most adverse conditions, in so far as the wiring is concerned. The successful operation of a plant frequently depends upon the ability of the erecting engineer to decide as to the details of wiring, as little or no consideration may have been given to such matters previous to the arrival of the generators and other machinery, especially if the contract includes his supervision of all construction. It is, therefore, necessary for the erecting engineer to be prepared to decide and answer questions upon this subject which will include the size of cable required for main and field leads and methods of supporting them; the location of switchboard, means of supporting it, and the best method of wiring from the generators to the switchboard and feeder lines. Should the station be used for supplying current over long distances for light and power, it frequently becomes necessary to decide as to location of transformers, number and location of lightning arresters and method of carrying feeders out of the station; and if the plant be that of a manufacturing concern, information is often required as to the wiring of shops for light and power, the best method of supporting motors and starters and sundry other electrical and mechanical data which does not strictly appertain to the work immediately covered by the contract. The writer has learned by experience that it is advisable to impart such information freely to local engineers and electricians when it is called for and sometimes without being called upon, when the general conversation indicates that such information will be appreciated. At times it is necessary to volunteer information to insure a satisfactory installation from the standpoint of the manufacturer of the apparatus. One must be careful, however, not to imply that the informant knows it all. It must be borne in mind that many local engineers have not had the advantage of general observation and experience which comes from installing apparatus in many stations of different construction; also that they are frequently familiar with local conditions, a knowledge of which would be of great value to the erecting engineer. Consequently there is often much to be gained by an interchange of information along these lines, not the least of which is the feeling of good fellowship and confidence which usually results.

Some of the various features requiring consideration by an erecting engineer in the equipment of a plant may perhaps be best given under the following classification:

1—Switchboard—Location, supports and instrument wiring.

2—Generator Cables—Size, method of support, terminals and connection to generator and switchboard.

3—Feeders—Size and method of support.

4—Lights—Location, number and kind.

5—Motors—Size, supports and method of drive.

6—Starters—Style and method of support.

7—Protective Apparatus—Fuses, circuit breakers and lightning arresters.

Switchboard.

The switchboard should be located so that all generator leads will be as short as possible, especially if the voltage is five hundred volts or less and where direct-current generators are to be operated in parallel and require leads of similar resistance. For high tension service the switchboard should be located with particular reference to safety, preferably above the engine room floor. The switchboard should be rigidly supported, using insulated braces if possible. If the angle frame is to rest on channel irons, the latter should be leveled and secured to the floor before erecting the panels. In placing panels care should be taken to get them level and plumb and to avoid leaving spaces between adjacent sections. When the panels are in place, the instruments and rheostats should be carefully mounted and correctly connected.

All small wires should be rigidly supported and all joints, no matter how small or apparently unimportant, should be well made. This can be accomplished by using the "Western Union" joint, which should be soldered and carefully taped. After the small wires are in place a coat of black shellac on all taped joints will add to their durability and appearance.

Generator Cables.

To determine the size of generator cables, the amount of current, voltage, and distance between generator and switchboard must be considered, such a size being selected as to make negligible the drop in voltage between the generator and the switchboard. The cables can be placed in conduit or exposed as may be best adapted to the particular requirements of the station. In alternating-current systems it is impracticable on account of the inductive effect to carry each lead in a separate iron conduit. Whether the system be single or three-phase all leads should be in one conduit of non-conducting and non-inductive material. With a two-phase system the two leads of each phase can be run in one metallic conduit, one lead neutralizing the effect of the other. When laying conduit, bends should be eliminated as far as possible, and those that are necessary should be of large radius. When cables fit tightly an application of powdered soapstone will make them slide through the conduit more readily.

The question of insulation must necessarily be given careful consideration, and the kind used will depend largely upon the voltage and method of support. If cables are to be laid underground and exposed to extreme dampness, properly insulated cables with lead sheaths are necessary. In some localities the Underwriters' Rules will largely determine the insulation which must be used whether wiring is installed in conduit, moulding or open work. When wiring is exposed the insulators and supports should be rigid so that the cables may be put under tension. To make a satisfactory appearance, all wiring should be strung tight and straight and all bends made at right angles. Whenever possible on long spans of heavy cable, it is advisable to use strain insulators at each end with a turn-buckle at one end.

Cable terminals at both the generator and switchboard ends should be carefully soldered. To do this successfully remove enough insulation from the cable end to allow it to enter the terminal to the full depth of the hole. Clean the cable end and terminal thoroughly and then heat the terminal and fill it with solder. The cable end should be heated at the same time and tinned in a pot of solder. Then the cable end should be inserted in the terminal, particular care being taken to see that the terminal, cable and solder are sufficiently hot to make a perfect joint.

Feeders.

After selecting the proper size of feeder the best means of support should be decided upon. The most modern and satisfactory method is to place all feeders, within buildings, in conduit, but on account of the extra cost for this class of work open work is frequently used. It can usually be installed in such a way as to give satisfaction except under certain conditions. Reference to the Underwriters' Rules will show, for instance, that open work is largely prohibited in cellars or elsewhere below street levels.

*From "The Electric Journal," by S. L. Sinclair.

Lights.

The size of wire used in buildings can be considerably reduced by allowing for a slight drop in voltage between the switchboard and the point of consumption. An allowance of five per cent is not excessive and is advisable in most cases, when generators can be operated at a voltage to provide for such a drop and thereby maintain the voltage required at motors or lights.

The illumination of buildings is an art in itself, and to secure ideal results requires much study and observation. The erecting engineer has, at least, had the advantage of observation and can therefore advise as to the proper placing of lights for particular purposes, after having found that certain methods give satisfaction in other buildings under similar conditions.

Motors.

The number and sizes of motors to be installed is generally disposed of at the time of placing the order for the generators. Subsequent units, however, are frequently required and the erecting engineer may be called upon for information in regard to them. The horsepower required to drive a given amount of machinery is always an uncertain quantity and to determine this it is well to make an actual test, using any motor of sufficient capacity that may be available. The tendency in most cases is to figure too closely, thereby keeping down the first cost but providing a motor too small for the purpose. Undue overloading of a motor has proven to be poor economy on account of the frequent repairs and the resulting expense and loss of time.

The method of drive and distance between centers is an important factor and deserves careful consideration. Should the distance be too short for proper belt surface on the pulleys, chain drive or gears can frequently be used to advantage.

Starters and Controllers.

The starter or controller required for a given motor will of course depend upon the characteristics, style and size of the motor and the purpose for which the motor is used. The controlling apparatus should be rigidly and securely installed and readily accessible.

Protective Devices.

It is advisable to use a switch and circuit breaker, or the two combined, to properly limit the current and protect the apparatus. This arrangement obviates delay due to the replacing of fuses at times of excessive overload. Although the first cost of a circuit breaker is greater than that of fuses, yet in the long run the former will generally be found to be the most economical.

Lightning Arresters.

When current is carried from or to buildings over aerial lines, lightning arresters should be used as a means of further protection to generators, switchboard, motors, lights and buildings. There are various types of apparatus on the market to suit the requirements of the different kinds of service, their selection and adjustment depending upon the voltage and capacity of the system and local conditions. The nature of the soil available for the ground connection, the immediate surroundings of the line especially as to other wires and the probable extent of the lightning discharges should be carefully considered.

System.

Much has been said and written with reference to the subject of systems, and too much stress cannot be laid upon its importance. It is essential to efficient management and workmanship, regardless of the nature of the work or business. In supervising the installation of the machinery in a power plant, the erecting engineer must first turn his attention to the calculations. Drawings and schedules covering apparatus and material to be installed must be prepared and a plan carefully thought out as to the method to be followed in placing the apparatus. The work can then be done more effectively in every particular and will invariably effect a saving of labor and material. If the work is properly systematized the personnel of the management or working force can be more or less changed without serious results, and this is especially desirable in the case of an electrical installation where the engineer in charge is liable at any time to be called away or detailed elsewhere. His successor can, under these conditions, continue the work with comparatively little difficulty.

ENGLISH TURBINE PROGRESS.

The turbine vessels of the year make a good-looking collection, set out as they are in this fashion:

Vessel.	Tons.	Builders.
Lusitania	33,000	John Brown & Co.
Mauretania	33,000	Swan, Hunter & Wigham-Richardson.
Immingham	2,009	Swan, Hunter & Wigham-Richardson.
H. M. S. Dreadnought	17,900	Portsmouth Dockyard.
Rewa	7,003	Wm. Denny & Brothers.
Creole	6,000	Fore River Company, U. S.
Yale	4,500	Delaware River Co., U. S.
Governor Cobb	2,525	Delaware River Co., U. S.
St. George	2,456	Cammell, Laird & Co.
St. Patrick	2,387	John Brown & Co.
St. David	2,387	John Brown & Co.
Marylebone	1,972	Cammell, Laird & Co.
Viper	1,713	The Fairfield Company.
Kingfisher	871	Wm. Denny & Brothers.
Duchess of Argyll	583	Wm. Denny & Brothers.
Atlanta	486	John Brown & Co.
Five T. B. D.'s	1,500	J. S. White & Co.
Three T. B. D.'s	631	J. I. Thornycroft & Co.

Here there are high-speed ocean liners, speedy cross-channel boats, a battleship, and several destroyers. Turbine vessels in course of construction and still to launch show quite as remarkable variety. On hand are certainly no "Lusitanias" or "Mauretanias," but there are three "Dreadnoughts" and three "Invincibles," and a new batch of fourteen destroyers. The only thing on which the world waits apparently is the cargo boat of which Mr. Parsons spoke at the Royal Institution last Winter, in which steam turbines were to be used in conjunction with reciprocating engines. If that combination prove successful, we imagine, the last will be heard of turbine criticism. A great deal of the criticism at present gets its color from hte trouble there has been with some of the propellers, and people listen to it as if there had never been any trouble with the propellers of reciprocating ships. Probably we are nearer a solution of the propeller problem, through these trubine trials, than we have ever been before. In any case the world of engineering will be none the worse for this reconsideration of the question in its elemental simplicity.

HIGH GRADE COPPER.

The native mass copper of Lake Superior has the highest electric conductivity of any known copper. A sample cut from the most compact portion of a mass, rolled and drawn into a wire of 0.104 inch diameter and annealed, gave a conductivity of 102.5 Mathiesson standard. Cathode copper, carefully deposited with a low current and prepared in the same way, gave just as high a conductivity.—"Scientific American."

ALCOHOL AND FUTURE POWER PROBLEM.

Modern civilization is based upon the use of power—upon engines of one type or another. In large measure the power is derived from fuel. In cooler climates our comfort in winter is to a great extent a question of cheap fuel, while the various processes, such as the smelting and working of metals, the making of glass, the baking of porcelain, and so on, are factors in the gradual exhaustion of available combustibles—coal, peat, oil, gas and wood of the forests. Practically our whole problem of over-sea transportation is a fuel problem. Our land transportation is the same to an almost equal extent. Occasionally a waterpower is available, to furnish, through the agency of electricity, the energy required for a railway, but the coal or oil-consuming locomotive will, doubtless, hold its own for a long time, except in the most densely populated districts. Where electric locomotives or trains are used, the power station will still depend in most cases upon fuel. The population of the world and the expenditure of fuel for heat, light and power steadily rises. A time must come when, under the continued and increasing drain, the cost of fuel will be increased, and the available supply diminished, until the advancing cost due to scarcity and distance of haul will at last check the consumption. Our heating in winter is a peculiarly wasteful process. Our buildings leak heat all over. We consume enormous amounts of fuel to maintain temperature conditions which are worse than wasteful. We oftentimes maintain temperatures indoors in winters in excess of those we seek in summer when we flee the city. In our heating and ventilating systems we assume that when we discharge the air we must discharge it hot, and take in fresh, cold air, giving it fresh heat from fresh fuel. This is all wrong. What we will be compelled to do when our fuel cost is increased will be to transfer the heat from the escaping warm air to the cold supply by a system of regeneration, supplemented by a construction of buildings which will cut off heat leakage and waste from that cause. In this way the air leaving a building will pass through a structure like a regenerator and will there deliver its heat to the incoming fresh air. Such regenerators can work at quite high efficiencies. The regenerating system will also be appplied more extensively than at present to furnace processes, and waste furnace heat will be conserved for various uses. But when all this, and more, is done, the fuel question will still exist. The crisis, though delayed, must assuredly come. It avails little to say that in China there is coal to supply the world for hundreds, if not thousands, of years. We may not control that supply; the cost of transporting it may make its use almost prohibitive. Our fuel supply is the result of solar radiation in the geological past. Energy of the sun was stored in the earth millions of years ago. Our waterpowers are the result of solar radiation in the present; the water evaporated from the tropic seas is deposited on the cooler heights of land, and we incidentally use a small fraction of the energy play involved. Solar radiation must continue to be the source of our power and heat. The growing plant can, by cultivation in the favored districts, be encouraged to assimilate, so to speak, the solar energy. We already have the timber of the forests, the brush wood, the straw of the wheat. field. The ideal fuel, however, is, undoubtedly, liquid fuel of a nature to be readily vaporized. If the liquid be of a limpid, non-viscous character, the difficulties found in pipeline transportation with the thick fuel oils will not stand in the way of such transportation and distribution. Fortunately, we have in ethyl alcohol an ideal fuel—colorless, limpid, of moderate boiling point, about fifty degrees below that of water, non-freezing, burning without smoke, mixing with water in all proportions, and, therefore, its flame extinguished by water, cleanly, drying off completely when spilled, not attacking rubber gaskets or packings, and non-corrosive for metal tanks and holders. The fact that its flame is bluish, or so-called non-luminous, means that the flame is almost devoid of free carbon particles, with their intense heat radiating power, a fact of considerable importance. When gasoline or heavy oils are burning, the flame, loaded with free carbon or soot, radiates heat to such a degree that it is not possible to approach near the conflagration, and combustible surroundings are readily fired by pure radiation of heat. The production of alcohol on a large scale is very simple, and the raw materials already exist in considerable variety. All saccharine or starchy growths are available. Saccharine wastes are now largely used in Cuba for alcohol production. At present it is said that the low grades of molasses can be delivered at American coast cities at about three cents per gallon. About three gallons of this crude product will be required to produce a gallon of refined spirit, or ninety per cent. alcohol, and the cost of production may be estimated at from three to four cents, making the cost of the alcohol per gallon about twelve cents. This alcohol will, in a properly organized engine, equal, volume for volume, gasoline now sold at a much higher price, in producing power. Even in the immediate future, then, it is evident that alcohol has a large field of usefulness. The farmer need not depend on wood, coal or oil for his power. His agricultural wastes will furnish it. His fields need only receive the sunshine, and be given sufficient water, and thence any crop yielding starch or sugar, however unmarketable otherwise, may be made the source of power, light and heat. The use of alcohol as a fuel, and as a source of power, will grow gradually. It would be idle to look for any sudden revolution in methods. It would, in fact, be very undesirable. Revolutions are destructive. Evolution, a slower process, is constructive. Gradually a system of production and distribution must be evolved, even for present needs. But when we extend our vision into the far future, we can only speak of possibilities or probabilities. There is always a possibility of new discoveries modifying conditions to such an extent that our best present judgment may be in error. But assuming that increasing scarcity and cost of mineral fuels will gradually stimulate the selection and use of substitutes, it seems reasonable to predict that the one substitute which possesses the most desirable qualities is ethyl alcohol. The amount that can be produced is practically unlimited. A very important fact distinguishing alcohol production by agriculture from the production and shipment out of the land of food products, meat, etc., or even wood, is that in the former the land is not impoverished, as the mineral and nitrogenous matters can be returned to it, while in the food and wood carried away the richness of the land is passing away, too. Alcohol contains only carbon, hydrogen and oxygen, all of which come from the air itself. The transformation is begun in the carbonic acid and water of the air reaching the growing plant under the influence of sunshine, and completed in the fermenting vat and the still under human direction. Vigorous plant growth is a cooling process; solar energy is rendered latent or potential. It would even be possible to calculate from the fuel value of any growth or crop the proportion of the solar energy so stored up. Fermentation renders the energy stored more available, and distillation finally yields a concentrated product. It is not unreasonable to expect that, in large engines of the internal combustion type when highly developed, we may attain efficiencies of thirty or forty per cent. This means that of the head units potential in the fuel, and liberated when it is burned with the oxygen of the air, about one-third may be converted into available power. It may even be that future invention will carry this proportion up to about one-half. With alcohol at a cost of ten cents a gallon—a price even now realized in Cuba—the cost of fuel per kilowatt-hour would be about one cent and a quarter on an assumed efficiency of thirty-three per cent. in the engine. It is not to be imagined that where coal or oil can be obtained at anything like the present costs there is at present any possibility of their replacement. Neither is it likely that waterpower, developed under favorable conditions, can ever have as a rival artificially-produced fuel. But inasmuch as the fuel cost is only a relatively small fraction of the total cost of operation of a

great system of distribution, such as that of an electric lighting plant or railway, it is evident that, considering the great convenience and adaptability of the alcohol vapor internal combustion engine, a wide field may be open for its application, as the cost of the fuel alone is a relatively unimportant item. Certain it is, that for isolated small powers the alcohol motor can soon be used with convenience and economy in America, following the recent legislation, removing the onerous tax. As to the more distant future period, we need have no misgiving. We are assured that mankind, by the introduction of methods of economizing heat, and by artificially producing liquid fuel, will be able to maintain those activities demanding heat and power until "the sun himself grows dim with age, and nature sinks in years."—Elihu Thompson, in "Gas Power," St. Joseph (Mich).

INSULATING PROPERTY OF ALUMINUM.

The property of aluminum as an insulator in certain solutions which allows current to pass readily from the solution to aluminum, but not in the opposite direction, has been discussed in connection with lightning arresters in a paper read at the recent meeting of the American Institute of Electrical Engineers. Although the coating formed on the aluminum in various solutions is a good insulator, it has not a very high dielectric strength. With many solutions it breaks down at about 120 volts. There are others, however, which enable it to stand several hundred volts. The hydrocarbons of the aromatic series are particularly useful, as has been pointed out by Pollak. But if the potential be carried higher than the limiting value, the surface film breaks down, the opposing resistance disappears, and a path of low resistance is formed. It is this property that is utilized in as may be required are placed in series, but the device may be constructed so that, while presenting good insulation for the normal potential of the circuit, a comparatively slight increase will be sufficient to cause it to give way. For example, a group of plates may be arranged to resist perfectly 10,000 volts, yet at 12,500 volts will give way.

If further experience with the aluminum arrester proves it capable of all that is expected of it, it will be a valuable addition to lightning protective devices. It is probable that those disadvantages which seem to have retarded the use of the rectifier and condenser will not be so serious here, for lightning arresters placed either at the main generating station or at substations are taken care of. It is only when a machine is placed in the hands of some less responsible person that it suffers from lack of attention. The electrolyte must be renewed and the cell kept clean—features which are very apt to be neglected by those who do not fully appreciate their necessity. It is possible that these features may be sufficiently disadvantageous to prevent the use of the aluminum discharger on transmission lines, particularly because such a device must naturally be placed under cover, and well protected from the weather. But at those places on the system where employees are constantly in attendance, or where inspections are frequently made, the necessity for a certain amount of attention may be an advantage rather than a disadvantage. These inspections will insure that the protective apparatus is always kept in first-class order.

It remains to be seen how far this method of protection will be carried. Mr. Jackson has used it rather satisfactorily up to 40,000 volts, and from the character of the device there seems to be no reason why it should not be equally as satisfactory for 50,000 or 60,000.

TELEPHONES IN THE FAR NORTH.

Few persons realize the extent of the system of the Alaska Telephone and Telegraph Company of Seward Peninsula. Over 1,000 miles of wire is strung between the various camps of that region. The line from Nome to Tin City is the longest wire that the company is operating, being 157 miles long It is the only line in Alaska in which a submarine cable carries the messages for a part of the distance. This cable is under Grantley Harbor, near Teller. To guard against accident, an aerial wire is also strung, the poles on either side being 120 feet high.

The second longest line is to Candle Creek, a distance of 138 miles, from Council, the course carrying it through the Council district. There are two lines to Kougarok, one of 122 miles and the other of 130 miles. A wide expanse of barren, uninhabited country is covered by the Candle line, which was the cause of much hardship and heavy cost at the time of construction.

At Craft's Roadhouse, near White Mountain and the junction of the Niukluk and Fish Rivers, there is a telephone which is kept busy from morning till night by freighters and merchants between Chinik and Council. All the camps along Solomon River are provided with telephones, as are most of those on Nome River, Dahl and Taylor Creeks. The main exchange is at Nome, where there are two local switchboards and one long-distance board. There are 130 camps and roadhouses provided with telephones, in addition to numerous uated within the "city limits"business houses and cabins sit of larger camps.

POWER AT NIAGARA.

The discussion upon the Victoria Falls project, which has continued in the technical and daily papers with considerable vigor for some time, naturally has brought prominently forward the great and rapid development of Niagara. The general trend of the last decade has been to utilize, where possible, any water waste which is within reasonable distance of a demand for mechanical power. It has been estimated that over 100,000,000 tons of water plunge per hour over the Niagara Falls, and as this great mass of water drops 165 feet, it is clear that there is an enormous amount of energy available. The engineers employed by the Government of the United States have estimated the horsepower available at the Falls as being about 6,750,000. It is almost impossible to grasp what this would mean in the way of coal consumption if it were all generated by steam. Clearly it would be quite impossible to establish an ordinary steam station of anything approaching this capacity. The Niagara Falls Power Company, it will be remembered, appointed a Commission, over which that grand old man of science, Lord Kelvin, presided. It was decided, a few years ago, to install twelve turbines and dynamos of 5,000 horsepower each, and later it was determined to duplicate this plant because of the growing demand for electric power.—The (London) "Engineering Times."

GIFTS FOR THE LAND AND BUILDING FUND OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

Samuel Insull, president of the Chicago Edison Company, and C. L. Edgar, president of the Boston Edison Company, have each contributed $1,000 toward the land and building fund of the American Institute of Electrical Engineers. Both of these gentlemen are members of the Advisory Committee of the land and building fund. F. W. Roebling, of the John A. Roebling's Sons Company, Trenton, N. J., a member of the Institute since 1887, has also contributed the sum of $1,000 to this fund.

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EDITORIAL.

Power Plant Economy

The American Civic Federation has for years endeavored to secure legislation by the Federal Government to the end that the use of water by the electric power companies at Niagara shall be limited. The desire of this public spirited organization is to have some action taken before it is too late, and the famous falls are nearly or completely destroyed for the sake of cheap power. Mr. H. W. Buck, who for a long time has been closely identified with the development of Niagara power, compares the loss to the country by neglecting to utilize the power of the magnificent water falls to a great conflagration in which $122,500,000 are annually lost. From the standpoint of the people it is then a question as to the value, directly or indirectly, of maintaining the present beauty of Niagara. It is extremely doubtful whether the amount of water used at the present time by all the power companies is sufficient to be really noticeable at the falls. But for the future there is cause for serious reflection, and manifestly we cannot have both the cheap power or ultimately save over one hundred million dollars per year of the nation's wealth, and preserve the falls as they are now and have been for ages past.

Money is never lacking when its investment reduces the cost of a necessary commodity. Power for an innumerable number of purposes is one of the greatest requirements of civilization. Its use has increased at a greater rate than has the population or the nation's wealth. Energy in no other form is to be compared with electric power for adaptability, ease of control or the efficiency with which it may be transmitted great distances. Under present modern methods and with the use of the largest and most efficient apparatus the cost of producing electric power, including all costs, is less than ever before. The use of electric power is attended with a minimum of attendance, annoyance or cost. Compared to the needs of the next century the present requirements for electric power are without doubt very small. From what source must this great necessary factor in the world's progress and life come? Whatever may be the source it is safe to assume that methods of the greatest economy and efficiency will be developed and used.

Many engineers are not only deceiving themselves but their clients in their interpretation of power plant economy. Rarely, if ever, is a generating station operated continuously under the most favorable conditions as regards maximum efficiency. Absolute reliability of operation, minimum attendance and fixed charges and the smallest average annual fuel cost per unit of output is what is wanted by the owners of electric power systems using fuel in any form as a source of power.

Notwithstanding this, engineers are much given to confine themselves exclusively to mere portions of the whole problem. The efficiency of a unit at full load, the consumption of fuel per indicated horsepower per hour at maximum economy, or the kilowatts on the switchboard per ton of coal or barrel of oil burned, at normal rating, are all of little value, extremely misleading and more than useless when considered by the general manager or the directors of the company in determining the actual cost of producing power as required in the operation of their distribution systems.

If a particular unit cannot be depended upon for continuous use under even adverse conditions and like an automobile, is repeatedly in need of adjustment and repair, even if its efficiency is of the highest, it would find few friends in a power plant from the president of the company down to the oiler. Again, the highest efficiency of operation may be more than counterbalanced by excessive attendance charges. The total fixed charges, such as interest, insurance, and depreciation, are often such as to exclude a particular type of apparatus from the generating station. But most important of all is it, that a plant should be of high efficiency, annually, under the conditions existing in the particular plant, no matter what these may be, and not momentarily at some predetermined output near the point of maximum economy.

It was with a genuine understanding of just such points as are outlined above, that a director of one of our largest electric light and power companies in California insisted upon a commercial test under the regular conditions of operation, this test to be continuously conducted for a period of three months, before his company placed the contract for a complete twenty thousand horsepower steam plant, and further insisted that all guarantees be based upon the results obtained

from the commercial test of ninety days' duration. It would be well if all engineers and managers of electric power enterprises followed in effect the almost extreme example set by this wise director. It is also of importance to note that this absolutely correct method of determining the real plant economy from the fuel standpoint was suggested by a director of the company and not by any one of its numerous engineers.

BOOK REVIEW.

"After Earthquake and Fire." A reprint of the articles and editorial comment appearing in the Mining and Scientific Press immediately after the disaster at San Francisco, April of April 18th.

This attractive little book will prove a valuable memento and record of the trying days subsequent to the catastrophe of April 18th.

The A. Lietz Co., San Francisco.—A well-bound, vest pocket size booklet has been issued by the A. Lietz Co., giving the Solar Ephemeris for the year 1907. This will be found valuable by all civil engineers and surveyors.

This company will soon be in their new four-story, reinforced concrete building, now in course of construction at 632-634 Commercial Street, between Montgomery and Kearny Sts. A catalogue will be sent on application.

Smith, Emery & Co., San Francisco, announce by means of an attractive booklet that they are prepared to make complete tests of construction materials, water, fuel and illuminants, etc., and also to make expert inspections of various kinds.

"The Treatment of Storage Batteries," by R. W. Vicarey, author of "Storage Batteries and their Electrolytes," illustrated, published by the "Electric Accumulator," 15 Queen Street, Cheapside, London. Price, 2/6, net.

The author of this book has been associated for sixteen years with the manufacture and care of accumulators, and his purpose in writing is to treat of the installation and care of storage battery sets.

The matter is presented in a systematic way with subheadings which make it valuable to engineers or others interested in this subject.

The Electric Journal following out the plan of previous years, have issued an index suitable for a card index system covering all the preceding volumes.

The adaptation of articles in the Electric Journal to every branch of electrical engineering work is well known by all electrical engineers, and it is needless to say that this index in connection with the bound volumes of the magazine, will be of great reference value.

The General Electric Co. have issued a very attractive booklet on "Electric Heating and Cooking in the Home." It is well illustrated and will be of general interest to every consumer of electricity.

TRADE CATALOGUES.

Wendell & McDuffie, of 26 Cortland St., New York, have published a new 24-page catalogue describing their asbestos and cement fireproof materials. The method of manufacture of these materials, which may be used as a substitute for other building materials, is well described.

A supplement is also issued giving drawings and dimensions of the different-size slates, and describing the various methods of laying.

Sprague Electric Co.—A handsomely illustrated catalogue, describing the "Electric Equipment of a Modern Hotel," has just been issued by the above company.

ELECTRICITY THE SAFEST OF ALL POWERS.

An able analysis of industrial accidents by Dr. Josiah Strong under the caption "Our Industrial Juggernaut" appeared in the mid-November issue of the "North American Review." No one can read this article thoughtfully without being impressed with the need of an awakening of American industries on the subject of accident prevention, and we earnestly hope that active measures will be taken to reduce the serious economic waste and suffering which careless methods of production invite. At the same time we can not help pointing out that Dr. Strong is greatly mistaken when he includes the increasing use of electricity in machine driving as a contributory cause of more and more industrial accidents.

The electric motor in itself is one of the safest pieces of machinery in the world. It is compact, can be placed in the most inconspicuous and convenient locations, may be made both moisture and fool-proof, will stand tremendous overloads without breaking down, can not explode and in certain types will run in water, dust, mud, chemical fumes and extreme heat or cold. If anything like decent engineering is used in adapting it to the work in hand it will operate for long periods with little or no attention, and without overheating.

The electrically driven machine is the safest of all, provided the machine is individually operated, and even if it be belt driven the hazard is no greater than with any other method. In fact it is less, for even with group driving, machines can be shut down when not in service, and there is less obstruction to light and air than with belts and shafting entire. And finally, the electric wire is safer than the steam pipe with its explosive powers, the gas pipe with its inflammable contents, or the compressed-air main with its heavy pressures and possiblities of rupture. Of course, high-potential circuits are dangerous if not properly installed and maintained, but the point is that there is an intrinsic accident hazard about other means of power supply that is quite foreign to electricity. In the largest field of electric motive-power application—the electrified steam railroad—we believe operating experience will prove that the electric locomotive is far and beyond safer than the smoke-emitting steam locomotive of the present; and in the smallest field of electric power—the operation of toy motors for children's play—there is no question about the greater safety of the electric machine in comparison with gas or alcohol toy engines. We believe that it can be demonstrated in every case that the use of electricity increases the operating safety of the industry which adopts it, and that any industry employing electric power in contradistinction to older methods will have fewer accidents as a result.—From the "Electrical Review," New York.

INCREASED VALUE OF COPPER EXPORTS.

According to a bulletin published by the Geological Survey the production of copper in the United States in 1905 exceeded 901,000,000 pounds. The three leading regions of production are Butte, Mont., Arizona and the Lake Superior region. In Idaho and Utah there was a marked increase, while in California and Tennessee there was a decrease. The total production for the world, in long tons, for 1905 was 701,252. The exports of copper in 1905 in its various forms aggregated in value $86,408,731, or nearly double the value of the exports in 1903.

ILLUMINATING ENGINEERING SOCIETY.

On Friday, February 8th, 1907, a meeting of the New York section of the Illuminating Engineering Society will be held in the Edison Auditorium, No. 44 West Twenty-sixth Street, New York, for the election of officers of the New York Section for the ensuing year. Mr. Thomas J. Litle, Jr., of the Welsbach Company, will present a paper on the "Photometry of Incandescent Gas Lamps."

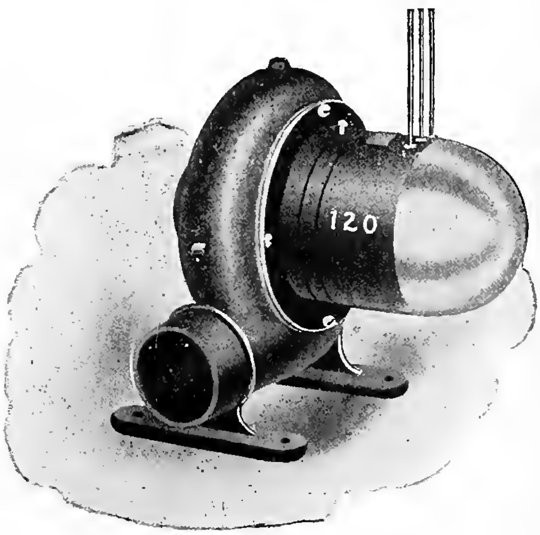
INDUSTRIAL

IMPROVED MOTOR-DRIVEN BLOWERS.

The illustration shows the motor-driven forge blowers manufactured by Roth Bros. & Co., Chicago.

Their distinctive features are: The blower wheel is mounted directly on the armature shaft; the blower casing is a part of the motor frame and carries one of the two bearings.

No other outfits can compare with these in efficiency, compactness and simplicity. They are a marked improvement over the usual form where the motor is just "stuck on."



Aside from the convenience and increased amount of work which can be done by their aid, the saving in cost for electrical power will pay for their installation in a few months. The motor runs only when the blast is required, and is stopped at other times. Speed controllers are provided by means of which the desired strength of blast is obtained, thus the electric power consumed depends entirely upon the amount of blast.

The motors are wound for direct or alternating currents, and are carried in stock in three sizes, suitable for horseshoers' fires, wagonmakers' fires and the large forges used in railway shops. Larger sizes are made to special order. Equally compact and efficient equipments have been made in sizes requiring as much as 40-horsepower, for supplying blast for large cupolas.

These blowers are also largely used for oil furnaces, gas furnaces, in starting gas-producer plants and many other places where low-pressure blast is required.

INCANDESCENT LAMP DISPLAY OF THE GENERAL ELECTRIC COMPANY AT THE CHICAGO ELECTRICAL SHOW.

The General Electric Company's collection of incandescent lamps is one of the features of the Electrical Show in the Coliseum at Chicago. Its exhibit space is thickly studded over head with the new incandescent units. Illustrations are given of all the newer lamps with various forms of Holophane reflectors. An ingeniously arranged flashing device presents the various forms and lights up, consecutively, Gem, Tantalum, Meridian and Tungsten lamps. There is also a "working" display of various standard carbonized filament lamps, including all of the miniature lamps. This is the first public exhibition covering all the different new types of incandescent lamps made in America, and illustrates in a most practical manner the wide range of illuminating units now available.

STARTING OF CARNEGIE STEEL GAS ENGINE.

Something over a month ago there was started at the Edgar Thompson works of the Carnegie Steel Co., Pittsburg, the first large gas power installation in America, using blast-furnace gas and double-acting, four-cycle gas engine of a large capacity. This event is of rather unusual importance as it marks the commencement of a new regime in methods of power generation of the U. S. Steel Corporation which has already taken so prominent a stand in favor of the internal combustion type of prime mover. The starting of the Carnegie engine also is of further interest for the reason that it furnished an effective demonstration of the capabilities of the Westinghouse design for the work in hand. This design, however, was by no means an untried one, as a number of gas engine units of similar design, but smaller capacity (500 horsepower) have been in operation elsewhere with success; but the Carnegie engine represents the first of the series of 12 large units (3,000 horsepower) which are now being built by the Westinghouse Machine Co.

The Carnegie blowing unit was started for the first time on December 7th, and after a trying out period of only two days, was then put into regular commercial service. Since then the unit has carried commercial load during the regular daily run without developing external or internal defects either in structure or operation. A rigid inspection of working parts after a few days' run failed to uncover the least evidences of wear or excessive stresses, and during a month's daily operation no prematures or backfires have occurred.

In design the gas engine follows the same general lines as those of smaller Westinghouse units, previously described in the technical press. It is of twin-tandem, double-acting style with center-hung flywheel and with two air tubs arranged in a "vis-a-vis" fashion opposing the two engine frames. The gas cylinders are 38 inches in diameter by 54 inches in stroke, and air cylinders 60 inches in diameter; normal speed 60 to 75 revolutions per minute. Engines of the same size are being constructed for electric work in which case the air tubs are removed and a generator mounted upon the shaft next to the flywheel. The generator will have a rated capacity of 1,500 kilowatts, running at 75 revolutions per minute. Such a unit is now under construction for the Edgar Thompson plant. The generator will be solid coupled and will deliver direct current at 250 volts.

Although this gas engine unit furnishes an uninterrupted supply of air for blowing purposes, the duty imposed upon it is by no means uniform. Owing to changes in the compactness of the furnace burden the air pressure must vary in proportion. The usual range is 14 to 20 pounds per square inch, except when the furnaces are tapped, when the pressure reduces to 5 pounds. On the other hand, when the furnaces are closely packed the pressure may increase to 20 pounds. These variations in pressure delivery are accompanied by corresponding variations in the quantity of air delivered, all of which is taken care of by the valve gear, while the speed of the engine is entirely under the control of a sensitive centrifugal regulator designed upon the relay principle but controlling the gas inlets individually and directly at the point of gas supply. A speed changing-mechanism provides means for manual control of the speed of the blowing unit when desired.

Compressed air is employed, as usual, for starting, and it is a point worthy of note that this large unit has been started and placed under full load in 53 seconds from the time of turning on the air, while one minute is ordinarily sufficient.

As the starting is automatic, only gas and air valves require attention of the operator at the time of starting, no other parts of the engine needing manipulation.

Much experience has developed during the past two or three years in the operation of large gas engines on natural gas. It is, however, a point worthy of note that the use of "dirty" gas, either producer or blast furnace, is a very different problem, so difficult as to establish a very narrow margin between success and failure where the necessary experience in its use has not previously been acquired. But in adopting the large gas engine as a standard form of prime mover in steel plants, the Carnegie Steel Co. has not been blindly dependent upon skill of gas engine designers. For a long period a 500-horsepower Westinghouse gas engine of design similar to the large unit was maintained in daily operation at the steel plant for purposes of experimentation. Experience derived from the operation of this smaller unit gave unusual promise, which seems to have already been fulfilled in the operation of the large unit. During a 30-day test of 24 hours per day, including Sundays, this experimental unit sustained regular commercial load with but two stops (equivalent to a run of 99 1-3 per cent. of the elapsed time). One of these stops was due to failure of gas supply. At the end of this run the engine was found to be in excellent condition, no unusual wear had developed at any point and all moving part were working freely. This excellent record is not a little due to the effectiveness of the lubrication and cooling systems which have been devised for this double-acting design of engine.

From every standpoint the results that have been achieved with the use of blast-furnace gas at the Edgar Thompson Works constitute nothing less than a vindication not only of the design, but also of the action of the steel companies in adopting gas engines for general motive power throughout every department of their works.

EXHIBIT OF THE H. W. JOHNS-MANVILLE CO. AT THE SECOND ANNUAL ELECTRICAL SHOW, CHICAGO, ILL.

At the Second Annual Electrical Show, held in Chicago from January 14th to 26th, the H. W. Johns-Manville Co., whose headquarters are in New York, will have an extensive exhibit. Among its other numerous electrical specialties will be exhibited a line of "Victor" Direct Reading Instruments. These will consist of "Victor" Direct Current Volt and Ammeters, "Victor" Combination Meters, both switchboard and portable types, as well as a special "Victor" Combination Meter for automobile use.

The "Victor" Combination Meters are the only direct reading electrical instruments of their kind on the market, giving a simultaneous reading of volts, amperes, watts and horsepower on one dial.

Among the other materials exhibited should be mentioned "J-M" Friction Tape. In this tape the friction is well worked into the fabric and runs true to gauge throughout the entire roll. This tape possesses an extremely long life under all conditions.

"Noark" Subway and Service Boxes are shown, of one, two and three-pole construction and 250, 600 and 2,500-volt capacity. "Noark" Subway Boxes are water-tight, being designed and tested to withstand a pressure of 25 pounds per square inch without leaking, and are, therefore, suitable for the most severe conditions. Also a complete line of "Noark" National Standard Fuses, Blocks and accessories, and "J-M" Overhead Line Material were shown.

"Transite" Controller Linings are made of "Transite" Asbestos Fireproof Lumber, an insulating material which absolutely prevents short circuiting or grounding of controller cover. "Transite" Asbestos Lumber is also made in the form of Fireproof Doors, for high-tension transformers and switches, in which case it serves to protect the apparatus from short circuiting and to prevent persons from coming into contact with the live parts.

3260 HORSEPOWER TURBINE WHEEL FOR THE POST FALLS PLANT OF THE WASHINGTON WATER POWER CO.

In September of last year Mr. D. L. Hintington, the general manager of the Washington Water Power Company, visited the different turbine builders in the East and made a thorough inspection of the I. P. Morris Company's plant, and of the six 10,000 horsepower wheels that they are constructing for the Niagara Falls Hydraulic Power & Manufacturing Company, of Niagara Falls, New York, and also of the five 6,625-horsepower wheels which they are building for the Aluminum Company of America.

On December 11th, 1906, the I. P. Morris Co., of Philadelphia, Pa., received an order from the Washington Water Power Company, Spokane, Washington, for one 3,260 horsepower horizontal shaft turbine unit for the Post Falls plant.

The turbine will be designed to operate under a head of 45 feet, and to run at a speed of 138 revolutions per minute, and will consist of two bronze runners on a horizontal shaft, the runners being about 66 inches in diameter. They are enclosed in a plate steel casing. The bearings will be of the generator type, and the outboard bearing will be a ring-oiling, thrust bearing, to take care of the unbalanced thrust of the runners. At the tail end of the shaft there will be furnished a suitable brake. This brake will be similar in design to those now used on the I. P. Morris Company's wheels at Niagara Falls.

The water will be distributed to the runners through cast-steel guide vanes, which are operated by links and an operating ring on the outside of the casing. This operating ring will be connected by suitable links to the governor piston.

It is as yet undecided what make of governor will be used. Both the Glocker-White governor, which is built by the I. P. Morris Company, and the Lombard governor are now under consideration.

The power house has still room enough for two more units, beside the new one which is to be furnished by the I. P. Morris Company, which will make a total number of seven units when all are installed. The maximum capacity of the plant will be 24,000 horsepower.

At the present time there are installed in the power house three 3,000-horsepower wheels, which were built by the Platt Iron Works, of Dayton, Ohio.

CHASE-SHAWMUT COMPANY.

On account of the great increase in demand for the staple specialties manufactured by the Chase-Shawmut Company, and the consequent need of more room and machinery in their factory, they have sold out their entire patented theatre switchboard interests to James S. Pennefather, of New York. The Chase-Shawmut Company ask for Mr. Pennefather a continuance of the liberal patronage heretofore bestowed upon them.

With more space and machinery the Chase-Shawmut Company are better equipped than ever for giving prompt attention to the orders they may receive.

The Standard Underground Cable Company's business has grown to the extent that they have recently opened branch offices at Atlanta, Ga., Los Angeles, Cal., and Seattle, Wash. Tese officers are subsidiary offices to their other regular branch offices.
branch offices.

NEWS NOTES

TELEPHONE AND TELEGRAPH.

San Francisco.—The Pacific Telephone and Telegraph Company, which succeeds the Pacific States Telephone and Telegraph Company, and the Sunset Telephone Company, by merger, completed its organization at a recent meeting held in Martinez, by electing the following officers: Henry T. Scott, President; Louis Glass, Vice-President; E. J. Zimmer, Second Vice-President; T. E. Sherwin, Auditor and F. W. Eaton, Secretary and Treasurer. The office of general manager was abolished. The papers in connection with the merger have been filed by the attorneys representing the two old companies. Portland, Ore., will be the future headquarters of the concern.

Reno, Nev.—Captain Merardi, President of the Reno Stock and Bond Exchange, states that the brokers of Nevada have been unable to reach a satisfactory agreement with the Western Union Telegraph Company, and that sufficient capital has been secured to begin the construction of an independent telegraph line from Reno to San Francisco and from Reno to Goldfield. This line will in all probability connect with the Postal Company in San Francisco.

Oakland, Cal—At a meeting of the Emeryville trustees, recently, the Home Telephone Company made application for a telephone franchise.

Stockton, Cal.—Thirty subscribers have been secured for the farmers' telephone line from Byron to Knightsen, and more are expected. Work on that branch has been begun and will cover about twenty miles of territory. The company has been organized under the name of Byron Farmers' Telephone Company.

San Luis Obispo, Cal.—New Huasnan Oil Company has been granted the right to construct a private telephone line on the outer edge of the county road from a point near the Pacific Coast depot in Arroyo Grande to the Porter ranch on the Huasna.

Lodi, Cal.—Some farmers along the Lockeford road have organized to put in a co-operative telephone line to connect with the Lodi system. Construction work is now being pushed.

TRANSPORTATION.

Glendora, Cal.—Active construction work on the extension of the Pacific Electric Railroad from Monrovia to Glendora by way of Azusa, has begun.

Guadalajara, Mex.—The city council of Tepic has granted to Leopoldo Villareal, an engineer of Mexico City, a concession for a street railway system in Tepic.

San Diego, Cal.—Extensive improvements are being made at the power house of the San Diego Electric Railway Company, in preparation for service on the lines building and contemplated and to provide power in case of a breakdown. Two steam turbine units have been ordered and two new boilers will be added. The company expects to put in feeder stations some distance from the present power house.

Los Angeles, Cal.—An extension of 9,000 feet of the Los Angeles Railway's Pico Heights line is contemplated in an application for a franchise made by Robt. Marsh & Co., to the board of supervisors.

Washington, D. C.—The proposed extension of the Tacoma Mines Ry. has been financed in New York and 16 miles additional track will be laid during the coming summer.

Washtucna, Wash.—Work has been commenced by Winters, Parsons & Boomer on a 2,400-foot tunnel through Devil's Canyon, south of Kahlotus on the Seattle & Portland project.

WATERWORKS.

San Francisco, Cal.—The report is current that the Spring Valley Water Company will submit a proposition to sell its plant in this city to the municipality and furnish a Sierra water supply for a stipulated monthly payment. No bonds are to be issued, but the water company is to be paid out of the monthly receipts of the city from consumers. The proposition includes the turning over to the city of all the mains, pipes and reservoirs of the company within the city limits. The water is to be delivered at the boundary line. While the scheme will involve the repairing by the city of all the dilapidated pipe lines of the company now laid in the city streets, the representatives of that corporation hope to be able to present a scheme so attractive that it will receive the approval of the public. It is claimed by those interested that under the plan to be proposed consumers, both domestic and municipal, may be supplied with water at a much less cost than at present, and yet leave a surplus with which to liquidate the principal of the indebtedness and interest by substantial monthly payments.

Winnemucca, Nev.—Tonopah and eastern capitalists are planning to work the rich placer deposits in American Canyon, 45 miles south of here, by collecting the waters of the different creeks on the eastern slope of the Humboldt slope and conveying the water in big pipes to the rich placer beds. The plans involve a big expenditure of money and embrace the purchase of water rights and a number of farms on the eastern slope of the range.

San Francisco, Cal.—Preliminary work on the plans for the proposed auxiliary system for protection against fire has been begun by City Engineer Woodward and Chief Shaughnessy, of the fire department, assisted by Civil Engineer T. W. Ransom and Superintendent of Engines, Gerter. The plans provide for three pumping stations on the water front by which salt water can be forced at high pressure through pipes laid in the down-town section and a complete system of cisterns installed throughout the city. City Engineer Woodward and Chief Shaughnessy announce that they will rush the preparation of data for submission to the Supervisors in order that the necessary ordinance to authorize the submission of the bond-issue feature of the scheme to a vote of the people may not be delayed.

Magdalena, N. M.—There is now a prospect of two water companies putting in a water system for this town.

San Francisco.—The Visitacion Water Company has filed a petition in the Superior Court for a judgment of dissolution. This action was decided upon at a meeting of the stockholders held January 3d. The capital stock of the corporation, which was incorporated in 1882, is $1,000,000. The directors are: D. B. Hinkley, D. H. Farquharson, C. D. Farquharson, W. A. Magee, D. E. Hayes and W. S. Downing.

OIL.

Bakersfield, Cal.—Col. Timothy Spellacy has arrived in this city from San Francisco, where he has been trying to effect an agreement between the Midway producers and the Standard Oil Company. The Standard was to take 3,500 barrels of oil at 30 cents, and to construct a pipe line into that district. Col. Spellacy announces that the deal is off, the Standard refusing to go higher than 25 cents. Nevertheless, the Standard is still surveying for the proposed pipe line. The Associated Oil Company has expressed its willingness to negotiate with the West Side producers. It is said that the Associated has made the producers an offer, and agrees to have a pipe line to Midway in the course of four months.

FINANCIAL.

San Francisco, Cal.—Those behind the merger of the Bell telephone companies of the Pacific Coast into one corporation, the Pacific Telephone and Telegraph Co., declare that their success is assured. Under the plan of the merger, there will be $18,000,000 worth of six per cent. preferred stock and $18,000,000 worth of common stock outstanding. The company declares that bonds to the extent of $3,000,000 have already been issued. The following statement was given out this week: "The California subscriptions received for the first-mortgage bonds, issued in connection with the financing, exceeded expectations, covering practically the entire issue which the company desires to sell at this time. At the request of the Boston correspondents of N. W. Halsey & Co., the bankers who are handling this issue, it is probable that a few days will be allowed for the receipt of subscriptions from New England, where control of the Pacific Telephone and Telegraph Co. is held, before the matter is entirely closed. The successful placing of this bond issue puts the company in funds to proceed aggressively with the plans undertaken for extensive improvements in practically all the important cities on the Pacific Coast. The San Francisco and Oakland systems are to receive special attention, the equipment to be of the most modern type, capable of giving the company's patrons the most efficient service which the present advanced state of the art permits."

San Francisco, Cal.—The Pacific Gas and Electric Co. has redeemed $250,000 worth of its bonds at an average of 87½. The highest paid was 89. Some of the offers ran as high as 96. It was the first annual redemption of the new bond issue of that company for $10,350,000, issued in January, 1906, at 5 per cent. per annum.

San Francisco, Cal.—At the last meeting of the board of directors of the Northern California Power Co. Edwin Goodall was elected a director to fill the vacancy caused by the death of James Coffin, who died some days ago. The directors of this company now are: H. H. Noble, J. Henry Meyer, C. R. Downs, Edward Coleman and Edwin Goodall.

San Francisco, Cal.—There have been numerous reports regarding the status of the regular dividend of the Associated Oil Co., recent news from the South stating that it would be paid. A decision upon the matter is expected within the next few days.

Bakersfield, Cal.—The Mariposa Road Oil and Development Co., with headquarters at Maricopa, held its annual meeting on the 8th inst., and elected the following directors: J. H. Gaddie, L. F. Gaddie, E. L. Weed, W. J. Schultz, F. F. Weed. The officers are: President, F F. Weed; vice-president, W. J. Schultz; secretary and treasurer, E. L. Weed. The work of the company is hampered by the car shortage, and it cannot fill all its contracts. The company has ten flowing wells which produce 6,000 barrels monthly, and it has 30,000 barrels in reservoir.

Bakersfield, Cal.—The annual meeting of the Monarch Oil Co. was held Jan. 12th, and the following directors were elected: J. L. Depali, A. Burness, D. Burkhalter, L. V. Olcese and J. B. Hewitt. The company owns 160 acres of patented land in the Sunset oil district, and has one flowing well.

San Francisco, Cal.—Notice is given that at a meeting of the directors of the San Francisco Coke and Gas. Co., held on January 15th, a resolution was adopted calling a special meeting of the stockholders of the company to meet at the office of the company, 14 O'Farrell Street, on March 25th, to consider and vote upon the question of increasing the bonded indebtedness of said corporation from $2,500,000 to $7,500,000. President Leopold Michels of the company says that the directors recommended such action to enable the company to extend its mains, the gas plant, and also to install a plant to manufacture and furnish electricity throughout San Francisco. He also said that the proposed increase in the capital stock of the company and its bonded indebtedness had no connection with the merger contemplated or under negotiation by other companies, and that his company had no connection with any proposed merger.

RAILWAY NOTES.

Laurel, Mont.—The N. P. Ry. Co. will build a disinfecting plant here.

Portland, Ore.—Not only will the Harriman railroads be extended from Portland to Puget Sound, but they will invade western Washington and the Olympic peninsula. Preparations are being made to construct branch lines to Gray's Harbor and Willapa Harbor, and terminal facilities are being secured at those points.

Seattle, Wash.—The board of directors of the N. P. Ry. have authorized extensive improvements upon the lines in the State during the present year. Upon the main line between this place and Spokane a total of 120 track miles of new steel rails will be laid. On nearly all the branch lines new 72-pound rails will be substituted for the old trackage.

Seattle, Wash.—Final plans for the building of a standard-gauge railroad from the southwestern coast of Alaska to the gold and copper mines of the interior will be announced in New York from the headquarters of the Guggenheim and Morgan interests. Wharves have been built at Cordova, grading work finished for 20 miles and definite surveys made for another 200 miles.

Spokane, Wash.—The contract for the grading and construction of the Northwestern railroad, an extension of the O. S. L., from Huntington, Ore., to Lewiston, Ida., has been awarded to the Utah Construction Co.

Spokane Traction—Fifteen coaches of the Detroit type have been ordered by this company, at St. Louis, for March delivery. The cars will be 41 feet in length and will accommodate 125 passengers. They are equipped with four motors of 40 horsepower each.

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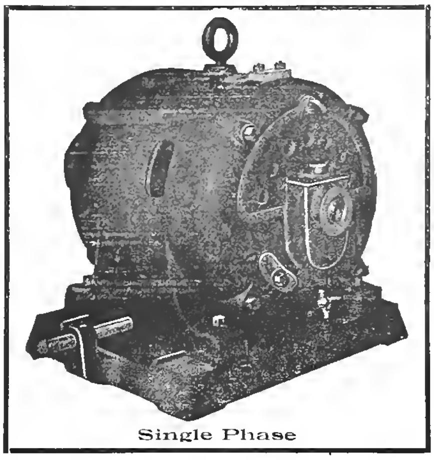

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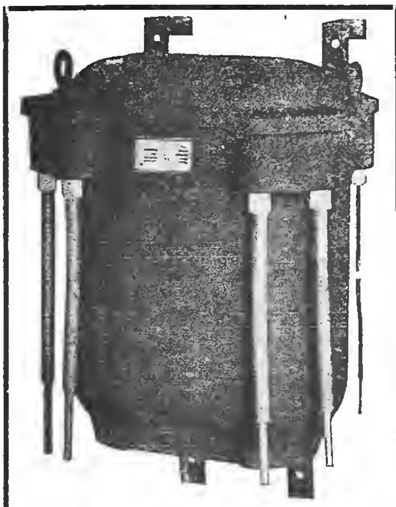

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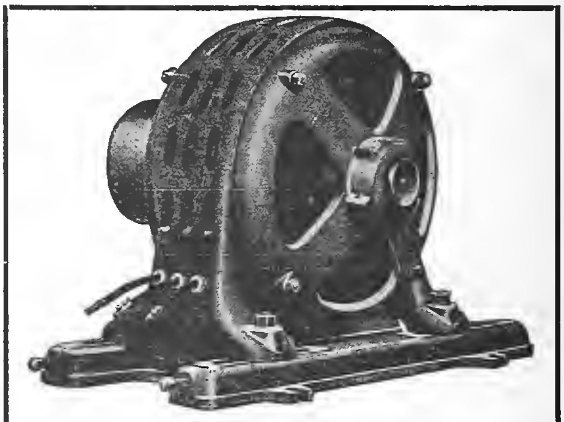

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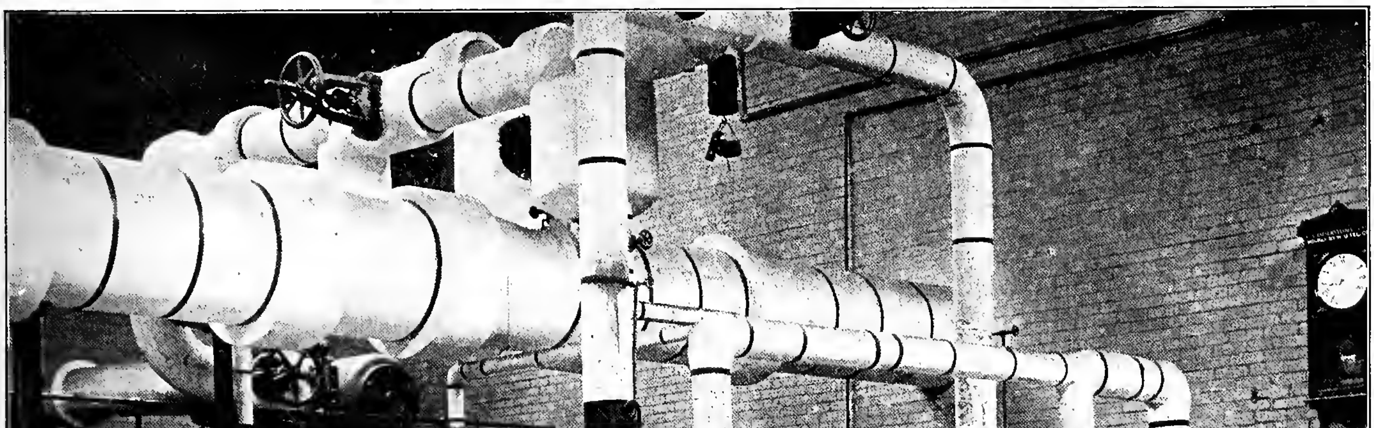
The Engineers' Architects' and Builders' News

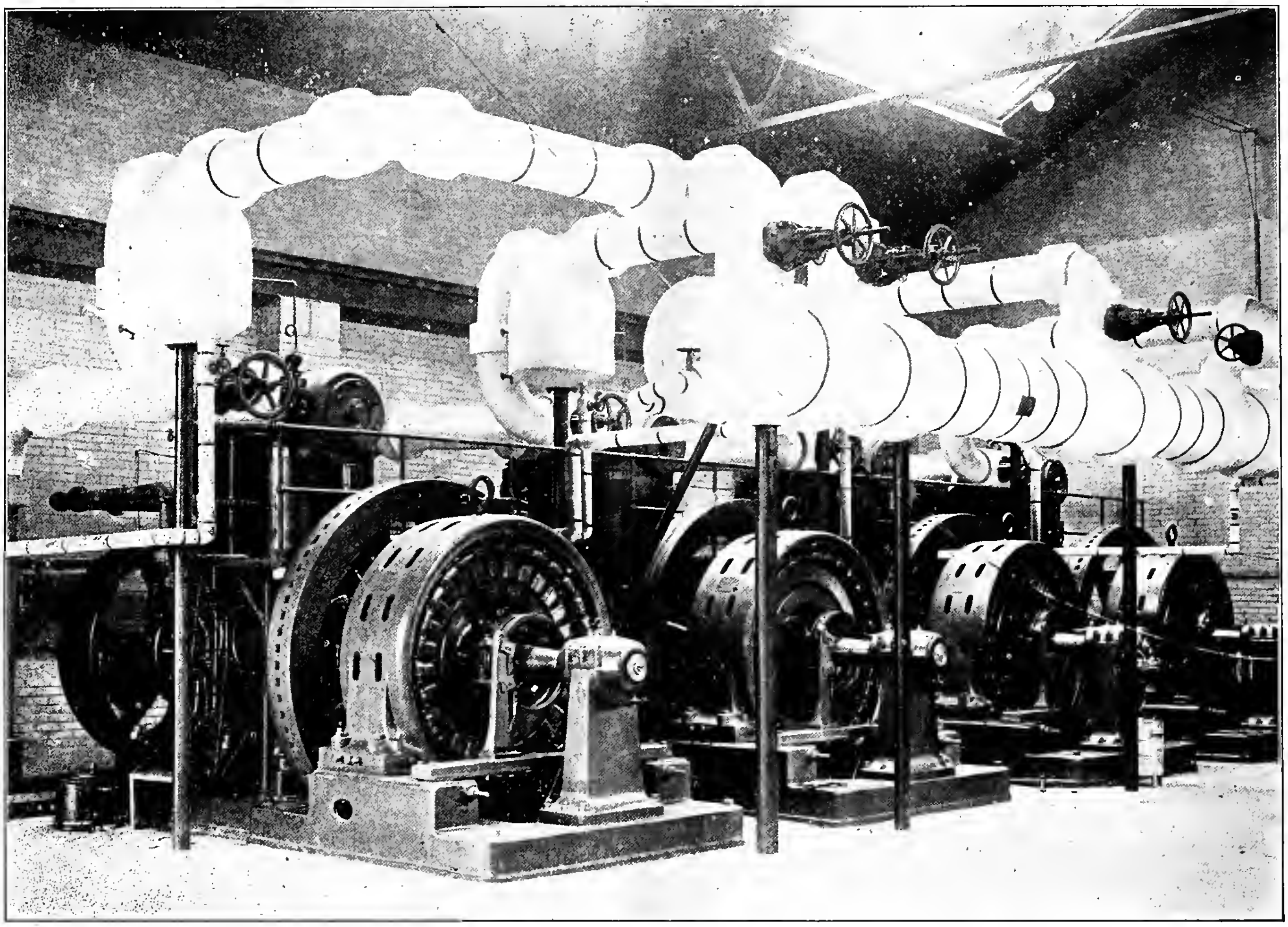
VOLUME XVIII. SAN FRANCISCO, CAL., FEBRUARY 9, 1907 No. 6

The New Power Station of the People's Light, Heat and Power Company, Springfield, Ohio.

The rapid progress made within the last few years in the design and construction of light and power stations is aptly illustrated by the new power house of the Peoples' Light, Heat & Power Company, at Springfield, Ohio. The building is of fire-proof construction and exceedingly well lighted and ventilated. The illustration of exterior shows the front and facing on West Jefferson Street. A spur from the P. C. C. & St. L. R. R. enters the building, providing a means for delivering coal on cars directly in the boiler room. Four Heine Safety boilers of 450 horsepower each furnish steam at 150



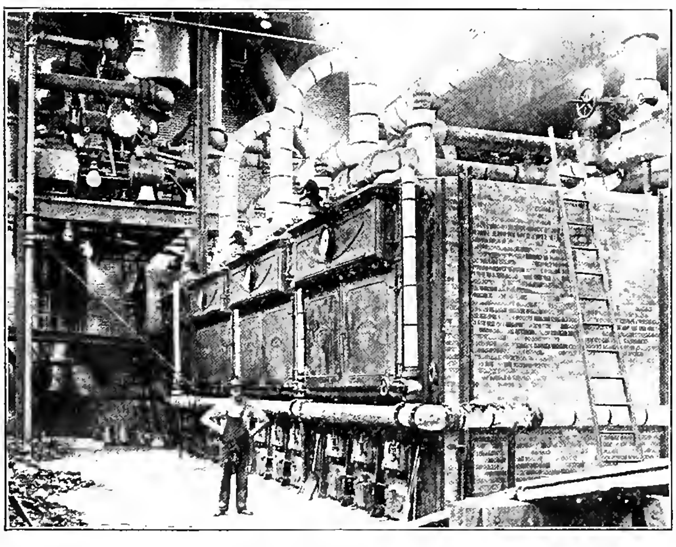
EXCITER UNITS IN FOREGROUND.



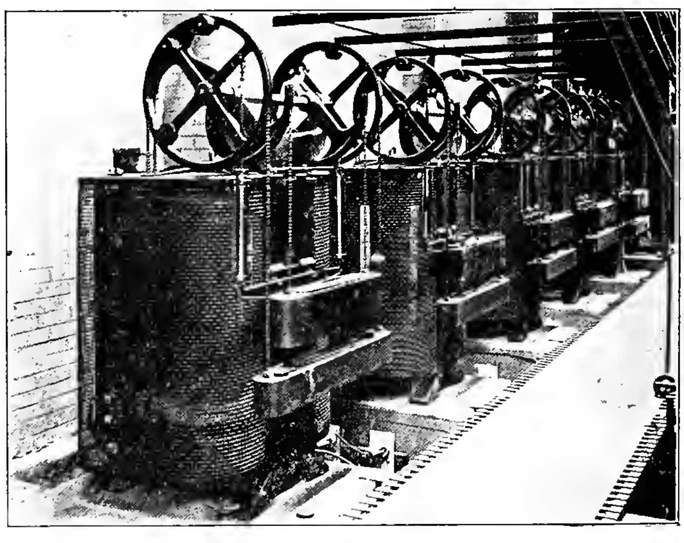
WESTINGHOUSE DIRECT CONNECTED GENERATORS.

pounds pressure to four Westinghouse automatic, compound, non-condensing engines of 400 horsepower each with cylinders 16x27-inch and 16-inch stroke, 257 revolutions per minute, which operate four 250-kilowatt, engine-type, revolving-field, two-phase, 60-cycle, 2,200 volt generators. Excitation is furnished by two 25-kilowatt, 125-volt, direct-current generators direct connected to two Westinghouse Junior automatic engines of 32 horsepower each, with 8x7-inch cylinders. These units are illustrated in Figure 4.

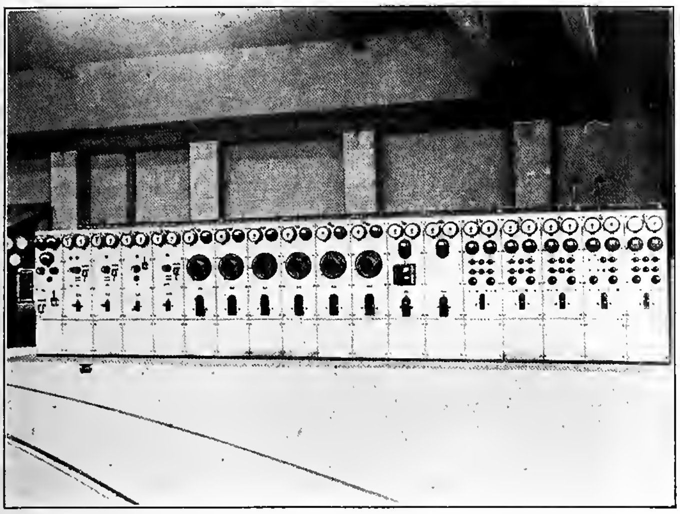
The switchboard is constructed of white Italian marble, and consists of eighteen panels as follows: One double exciter panel on which is mounted one voltmeter, two ammeters, two field rheostats, two double-pole knife switches and a voltmeter plug; four generator panels provided with two ammeters, field switch, rheostat, type-D oil switch and voltmeter receptacle; six feeder panels, on which are mounted an ammeter, single-phase integrating wattmeter, Stillwell regulator and type-J oil circuit breaker; two power panels,



BOILER ROOM.



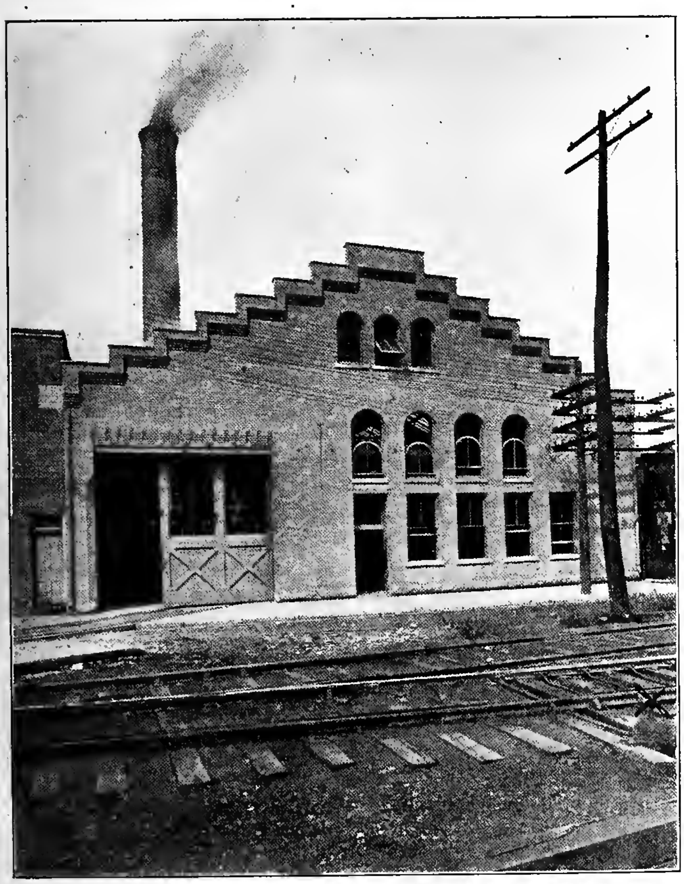
ARC LIGHT TRANSFORMER.



SWITCH BOARD.

each provided with two ammeters, a polyphase integrating wattmeter and type-F oil switch; four standard constant-current regulating transformer panels. A swinging bracket is provided on which are mounted two voltmeters and one synchroscope; this, with a Tirrell regulator, completes the switchboard equipment.

Immediately behind the switchboard are located five Westinghouse 100-light, two-circuit, air-cooled, constant-current regulating transformers, 2,200 volts primary, which furnish current for 378 series alternating-current arc lamps for street lighting, the Peoples' Light, Heat & Power Company having the contract for lighting the streets of the city.



EXTERIOR OF POWER HOUSE.

Aside from the city lighting, this company does a large commercial business, furnishing current for Nernst, incandescent and multiple arc lamps and motors.

The entire equipment of the power house is striking in its uniformity, which is a great contrast to the older stations where many different types of machines are generally found,

HYGIENIC ILLUMINATION.

The unfriendly have frequently contended that gas lighting was not healthful by reason of its vitiating the air of rooms, but they have yet to point out actual cases of positive injury resulting therefrom under normal conditions. The same cannot be said for electricity, for, although the incandescent bulbs do not deliver carbon dioxide into the air, they injure the eyes for the benefit of which they are used instead of assisting them, by reason of both insufficient illumination and the blinding glare of exposed filaments burning their images into the retina of the eye until the nerves are seriously affected. The customer who buys electric light finds it expensive, tries to economize and the invariable result is insufficient light. To get the most for his money he places the light near the thing to be illuminated, right in the range of vision where the glowing filament is generally impressed on the less used portion of the retina and serious eye fatigue results. This would not be so reprehensible if the customer himself were the only one affected by this attempt at economy, but he subjects his family, his patrons or school children to an enforced torture, those who are defenseless against this insiduous evil; eye strain results and often permanent injury.

If there is anything we need more than another it is our eyesight and a direct and strenuous attempt should be made by all interested in the lighting business to make the eye the first and only consideration in designing lighting installations. By avoiding sharp contrasts, making general illumination soft and uniform, keeping all intensely bright lights out of the line of vision and deriving local lighting from large lighting surfaces, much can be accomplished, but the subject should be thoroughly investigated at once and lighting rules adopted and put in force.

This is a subject for the Illuminating Engineering Society to handle. They have been running to electricity very largely, and it is to them we look for electric-lighting policy. They could very readily compile a set of lighting rules and see that these get into the hands of all lighting companies for consideration, revision or adoption. Carbon dioxide has been present in rooms since the days of cave dwellers, and we can put up with it a little longer, but these intensely glaring light sources are so recent as to have their evil effects not generally understood, and this is all the more reason that immediate attention should be paid to them.—From "Progressive Age."

AVOIDABLE ACCIDENTS.

The census for 1900 shows that during that year there were reported 57,513 deaths by accident and violence in the United States, with an accompanying number of non-fatal casualities many times greater. Without increase of the annual rate reported by the government in 1900, there will be 575,000 persons killed every ten years, besides some 5,000,000 injured, even if the proportion of accidents to the population should prove to be no greater in this country than that of France. According to President Strong of the Institute, this would be equivalent to massacring every inhabitant in three cities the size of Indianapolis, Kansas City, and Denver every ten years, and at the same time maiming and mangling every man, woman and child in Washington, Oregon, California, Nevada, Utah, New Mexico, Arizona, Colorado, Wyoming, Idaho, Montana and Oklahoma, and doing it every ten years.

EUCALYPTUS AS A HARDWOOD.*

By O. M. Boyle, Jr.

Although the Eucalypts are natives of Australia and the adjacent islands, their adaptability to varying conditions of soil, etc., provided the climate be semi-tropic, has favored their propagation throughout some other parts of the world, notably, California and Italy.

In Australia the different species (there are over 150 in all) occupy situations varying from deserts or dry, mountainous regions to low, swampy and moist mountainous ones. This fact has favored the introduction upon this continent of a great number of species. On the western coast, and particularly in the southern and central parts of California, Eucalyptus should be an important timber product. As yet, the value of the wood is not fully appreciated in this country, owing to the fact that it has been grown here only in comparatively recent years. The first trees to be planted were the Eucalyptus globulus, in 1856, but it was not until 1870 that any extensive forest planting on the genus was attempted. Hon. Ellwood Cooper, of Santa Barbara, was the pioneer in this line. Within the last 30 or 35 years Eucalypts have flourished and spread so rapidly that they are now one of the most common of our California trees.

The wood is used variously in this country. While growing the trees serve as a forest cover to mountains, hills, plains and swamps, and as wind-breaks. In this latter capacity they are very popular in the southern part of this State, serving as a protection to groves of orange and lemon trees. They are also the source of many gums and resins and of honey. When cut they furnish excellent fuel and yield an oil, said to possess valuable medicinal qualities.

The rapidity of their growth, enabling them to reach the stature of trees in a very few years, has been the principal cause of the popularity of the Eucalypts. It is this quality which makes them particularly valuable for wind-breaks and for fuel.

Most species, if pruned or if cut off at the ground, sprout freely, sending up shoots which usually make a very vigorous growth. This makes it possible to cut the trees for fuel or timber and in a comparatively short time to have again a forest containing as much timber as before the trees were cut. A Blue Gum (Eucalyptus globulus), 8 to 10 years old, if cut to the ground, will send up shoots which will reach a height of 75 or 100 feet in from 6 to 8 years. Several other species make an almost equally rapid growth after being cut. The cutting may be repeated every few years for an indefinite period. If the wood is to be used for timber purposes it is well to allow it to reach maturity before cutting, since recent tests, forming the basis of this article, show that strength increases very rapidly with its age.

It has been only within the last few years that the value of the wood for timber has begun to be recognized in this country. In Australia it is used almost exclusively as a hard wood for such purposes as tool handles, carriage stock, street paving, etc. Blocks of Karri (Eucalyptus diversicolor), are laid as an improved pavement in the streets of Australian cities. These blocks are placed on end upon a firm foundation and the interstices filled with hot asphalt, mixed with gravel, etc. The surface thus formed is very durable and shows excellent wearing qualities. Many of the species have proven valuable for structural purposes, such as bridge timbers, piles, etc. The major portion of the hardwood lumber exported from Australia is Eucalyptus.

In America the Eucalypts have not yet been grown long enough nor extensively enough to have a source of lumber. The principal uses made of the timber thus far are for fuel, piles, posts and some of the parts of farming implements and for insulator pins on high-tension transmission lines. Eucalyptus globulus has found favor as pile material along the coast. It is extremely durable and is said to resist the attacks of the marine animals. Mr. Cooper, of Santa Barbara, has sold from his groves nearly $10,000 worth of piles in the last ten years.

As an evidence of the growing popularity of Eucalyptus timber for structural purposes the recent action of the Santa Fe Railroad may be mentioned. This road, acting upon the advice of Mr. E. O. Faulkner, manager of the Tie and Timber Department, has purchased 9,000 acres in San Diego county, which it is planting in various varieties of Eucalyptus. Mr. Faulkner was persuaded to this action largely on the basis of a progress report recently rendered the Forest Service by Mr. L. E. Hunt, Engineer in Timber Testing.

In a paper read in 1904 before the El Cajon Farmers' Institute, L. H. Dodson, who has made a thorough study of Eucalyptus, said:

"Land along hollows, too rough to plow, ground covered with bowlders, but which has a deep soil, a thousand places could be found that will just suit Eucalyptus. For the best results the trees should be planted much closer together than they are expected to stand when large. In this way they shade the ground, protect the roots from the heat, cover the ground with leaf mulch, and keep out the dry, hot winds which are so trying on young forests. As the trees grow they may be thinned, though care should be taken not to let in too much sun. At four or five years of age trees taken out are often worth a great deal as fence posts, or even sometimes for more important uses. By the end of ten years there ought to be a good many trees ready for railroad ties or posts, and there will still be a considerable number to grow for lumber if you care to wait for it.

"Just how long it will take to raise a saw log depends on many things. Mr. Gillespie, of San Jose, had a Blue Gum tree cut which made $8.75 worth of lumber, besides three cords of wood. As to the age of the tree I cannot say, but Mr. Lieb, of San Jose, sold a tree 30 years old which measured about five feet in diameter and made 6,000 feet of lumber, beside the firewood gotten from the top. It is not by any means necessary to wait until the tree is five feet in diameter before cutting it into lumber. It is common to see a tree 12 or 14 years old which would make a very respectable log, and I have known of Eucalyptus being sawed at ten years old. Near Los Angeles it seems to be generally understood that from five to seven years is about time to wait before cutting for firewood."

Under favorable circumstances the Blue Gum makes the most rapid growth, but it does not endure the frost well and it is too much of a lowland tree to be expected to stand the dry hillsides without irrigation. The wood is valuable for many purposes, but it will not last long under ground, so it is a poor tree for fence posts, although it makes good piles in salt water, owing to the fact that the toredo will not eat it.

The Sugar Gum (E. corynocalyx) it not as rapid a grower as the Blue Gum in moist land, but will often outstrip it in dry situations. It will stand more heat and a great deal more drought than the Blue Gum. It makes excellent fence posts, as it endures very well under ground. It is one of the strongest of the Eucalpyts as regards mechanical properties, and is too valuable as a hardwood timber to use as fence posts where there are facilities for sawing it.

The E. rostrata grows rather faster than the Sugar Gum and will stand several degrees more cold than either of the preceding species. It will almost equal the Sugar Gum in resisting drought and will stand considerable alkali. It is a very lasting timber under ground, makes a better quality of fuel than the Blue Gum and is considered by many to be better for piles. It does not show as great strength, however, in laboratory tests, and is probably not as good for structural purposes.

The E. diversicolor, or Karri, is a tree to be planted in good bottom land. It is not able to withstand drought, but will endure frosts. It makes a straight-grained timber and

*Reprinted from "California Journal of Technology."

is of excellent quality, being even stronger than the Blue Gum. It is also one of the best honey trees.

Trade Bulletin No. 8, issued by the Bureau of Forestry, discusses the value of Eucalyptus when used as timber. It says:

"The wood of the Eucalypts has not been extensively used by manufacturers in the United States, because the supply has not been sufficient to establish a market. Blue Gum, the most common species in California, has, however, competed with Black Locust for insular pins, has given satisfactory service as chisel and hammer handles, and has been used

SHOWING THE FIBROUS CHARACTER OF EUCALYPTUS GLOBULUS THE SPLITTING OF THESE LOGS WAS ACCOMPLISHED WITH MUCH DIFFICULTY

locally for wagon tongues, axles, shafts, spokes, hubs and felloes. It is hard, strong and tough.

"Blue Gum is by far the fastest growing species. The were taken is given in the following table. All the trees were about 15 years old. The Eucalyptus globulus, had, however, grown under more favorable conditions than the other trees:

Common Name.	Species Botanical Name.	Diam. in Inches.	Ht. in Feet.
Blue gum	Eucalyptus globulus	30	101
Sugar gum	Eucalyptus corynocalyx	15	73
Karri	Eucalyptus diversicolor	16	72
Manna gum	Eucalyptus viminalis	12	60
Red gum	Eucalyptus rostrata	9	47
Leather-jacket	Eucalyptus punctata	10	43
Red Mahogany	Eucalyptus resinifera	8	38

"An important point in considering the value of the commercial planting of Eucalypts is brought out in the following table, which shows that the fastest growing are also the strongest:

		Bending.		Compression parallel to grain.	
SPECIES	Age in Years	Number of Tests	Mod. Rupture lbs. per sq. in.	Number of Tests	Crush Strength lbs. per sq. in.
Sugar gum	15	5	25,344	11	11,290
Blue gum	30	12	23,265	15	12,310
Leath.-j'ck't	15	3	19,267	10	10,908
Karri	15	8	18,386	17	8,795
Blue gum	15	28	16,900	34	8,190
Red Mahog.	15	4	14,550	2	7,920
Red gum	15	9	13,093	20	7,309
Manna gum	15	12	14,380	6	7,723

"A comparison with Forest Service tests on hickory shows that 30-year-old gum is stronger than XXX hickory, and that 15-year-old sugar gum is nearly as strong as black hickory, and 91 per cent. as strong as second-growth hickory.

"The wood of the very young and sappy trees is apt to warp, but that from more mature growth can be easily handled to prevent warping. Early seasoning should proceed slowly. Open piling is desirable. The stacks should be high to secure weight, and should be covered."

A few figures will probably be interesting, showing the immense profits that may be made out of Eucalyptus planting when done commercially. It is recommended by those familiar with the species that the trees when first planted be placed four feet centers. This will allow approximately 2,600 trees to be planted to the acre of ground. In the drouth of about ten years ago it was noticed that the trees where close together produced quicker cover and withstood the dry seasons better than their neighbors, placed farther apart. After about six years, however, they will begin to crowd each other and three-quarters of them may be cut for fuel. According to practice, the average Blue Gum or other fast-growing tree will furnish one-quarter cord of wood at the age of six years. This means about 480 cords of firewood from the trees cut, and there are still left 650 trees to be grown for timber on that one acre of ground. At the end of fifteen years the table above from the Forest Service Trade Bulletin shows the average diameter at the butt to be, say, 12 inches, and the average height to be in the neighborhood of 80 feet. This means that there will be about 150 feet of timber in the tree, of which, allowing for shrinkage, etc., only 100 are available for lumber. In a more mature tree a higher percentage might have been assumed. This value is believed to be on the conservative side. 650x100 gives 65,000 feet of lumber, which may reasonably be expected from one acre at the end of fifteen years. The prevailing prices of Eucalyptus lumber vary slightly, but may be taken as $100.00 per thousand when sawed and seasoned. Logging, sawing, seasoning and marketing would cost in the neighborhood of $50.00 a thousand, depending, of course, upon the accessibility of the grove, etc., leaving a profit net of $50.00 per thousand. 65 x $50 gives $3,250 net, as the value of the lumber on one acre at the end of fifteen years. From the 15-year-old trees the slabs and tops it is estimated would make 300 to 400 cords of fuel, from which a profit of $3.00 per cord could be expected. This, together with the fuel obtained at the end of six years would total a profit of $2,000 for the fuel alone. Adding this to the profit obtained from the lumber, the owner would realize $5,250 on one acre of land in fifteen years. This sum seems large when it is remembered that the land upon which Eucalyptus will grow readily is often not of the greatest value for other purposes. A prospective planter must not, however, fall into the fallacy of buying poor land. A small increase in the original investment, if it secures better land, is wise. The trees will grow faster, producing a large yield of good timber, which will more than repay the additional cost. Under any circumstances the initial cost is comparatively small alongside of the returns which may with reason be expected. The prevailing price for a tree on the stump at the age of fifteen years is about $3.00, which is based upon the value of the wood for fuel. At this rate the 650 trees would be

worth $1,950 standing at the end of fifteen years, and the grower would be relieved of the bother of cutting and disposing of the timber. All this, of course, is in addition to the money realized from the firewood at the end of six years.

If the owner felt that he could afford to allow his money to be tied up for thirty years it would pay him to allow the trees to stand for that length of time. The wood would then have increased nearly 50 per cent. in strength, as recent tests show, and would be more valuable in every way. A greater proportion of the tree would be available for timber purposes. A conservative estimate would place the average diameter of the butt at 20 inches. Cases have been known where a diameter of 60 inches was reached in thirty years, but this is very rare. Assuming, then, a diameter of 20 inches, the B. M. to be expected would be, approximately, 540 feet. 540 x 650 gives 351,000 feet in the acre. At $50.00 per thousand net, this would realize about $17,550 per acre for thirty years. This shows an even greater yearly profit than would be realized by cutting every fifteen years, but, of course, does not give as quick returns for the money. These figures are not claimed to be accurate, but merely show the order of magnitude of the profits to be made.

An outside estimate of cost, including purchase of land, of young trees, preparing ground, planting, care-taking for fifteen years, insurance and interest on invested money, places the sum at $250.00 per acre. This is a very small outlay compared with the possible returns.

Two years ago, so far as is known to the writer, no consistent series of tests had ever been made to determine the mechanical properties of Eucalypts grown in this country. The first work to be done along this line was undertaken by Mr. E. L. Soule and Mr. Thomas Williamson. The results of the ninety-five tests made by them were submitted as a thesis at the University of California. The timber tested by them was all Eucalyptus globulus, having been obtained from two trees, approximately thirty years old, cut on the site of the Greek Amphitheater. The exact age of the trees is uncertain, as no record of the date of planting had been kept. It is impossible to determine the age of an Eucalyptus accurately by counting the annual rings, as is usually done. The growth of the tree is so rapid and of such a nature that there is no clearly defined difference between the Spring and Summer wood. An observer, unfamiliar with this genus, would be liable to err in this matter, as the cross section shows rings of different color. However, there is apparently no direct relationship between these rings and the years of growth.

This wood was seasoned in the logs, under cover, for approximately fifteen months and tested in the Spring of 1904. Mechanical tests were made on 4x4-inch pieces in cross bending, compression parallel to and at right angles to the fiber and shear. Determinations were also made to ascertain the per cent. of moisture in the specimens at the time of test.

A table showing the results obtained follows:

(Modulus of Rupture, stresses and shears given in pounds per square inch. Modulus of Elasticity in 1,000 pounds per square inch.)

Flexure—19 Tests.

	Average	Maximum	Minimum
Breadth of Beam	3.84″	5.20″	2.97″
Height of Beam	4.60	5.75	3.76
Length of Beam	52.20	76.00	46.00
Fiber Stress at Elastic Limit	8610.	10300.	6550.
Modulus of Rupture	13880.	15600.	12270.
Modulus of Elasticity (1000 lbs)	2827.	3456.	2210.
Modulus of Elastic Resilience (lbs)	1.52	2.27	0.80
Moisture, per cent.	43.8	53.5	36.4
Rings, per inch	2.8	3.7	1.8
Specific Gravity—at test	0.99	1.08	0.91

Compression Parallel to Fiber—19 Tests

	Average	Maximum	Minimum
Fiber Stress at Elastic Limit	4470.	5540.	2670.
Fiber Stress at Rupture	5900.	6850.	3275.
Modulus of Elasticity	1444.	1731.	770.
Moisture, per cent.	40.6	49.6	32.3

Compression at Right Angles to Fiber—19 Tests.

	Average	Maximum	Minimum
Fiber Stress at Elastic Limit	1368.	1679.	964.
Moisture, per cent.	43.4	49.6	36.4

Shearing—19 Tests Radial—19 Tests Tangential.

	Average	Maximum	Minimum
Radial Shear	1503.	1865.	1221.
Tangential Shear	1995.	2522.	1568.
Moisture, per cent. Radial	40.4	51.5	28.2
Moisture, per cent. Tangential	40.9	56.3	28.2

During the past fifteen months extensive mechanical tests have been made on Eucalypts by the United States Forest Service at the Civil Engineering Laboratory of the University of California. These have been under the direction of Mr. L. E. Hunt, engineer of tests. The funds for carrying on the work have been provided under a co-operative agreement between the U. S. Forest Service and the State of California. At present over 2,000 tests have been made on this wood. Most of the specimens have been small, 4x4-inch or 2-feet x 2-inch in cross section. A general summary of the results has been given in the extract from the Forest Service Trade Bulletin, quoted above. More detailed results, showing quantitative effects of various factors, such as seasoning, etc., will soon be published in pamphlet form at Washington, D. C.

Bibliography.

The following is a reference list of the principal works which have been written on the genus Eucalyptus, many of which have been used freely in the preparation of this article.

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Trade Bulletin No. 8, Forest Service.

Forest Culture and Australian Gum Trees, by Hon. Ellwood Cooper.

Eucalypts from the Esthetic, Botanical and Utilitarian Standpoints, by Hon. Abbot Kinney. Published by Baumgardt & Co., Los Angeles, Cal.

Prof. L. H. Bailey's Cyclopedia of American Horticulture, Vol. II. Article on Eucalyptus, by Mr. J. Burt Davy, formerly of University of California.

Foreign.

Baron von Mueller's Eucalyptographia, published by the Government Printer, Melbourne, Australia. Very complete and good.

By Rev. Wm. Woolls, of New South Wales, "The Genus Eucalyptus" and "The Plants of New South Wales."

Various Bulletins, Papers, etc., by Joseph Maiden, Director of the Botanical Gardens at Sydney. These treat of Eucalypts as timber trees in Australia and are exceedingly valuable.

Les Eucalyptus, by Felix Sahut, of Montpelier.

Eucalypts Introduced Into the Mediterranean Region and Description and Use of Eucalypts Introduced Into Europe, by Chas. Naudin, Director of the Botanical Laboratory at Villa Thuret, Antibes.

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FIRES CAUSED BY ELECTRICITY AND GAS.

In his address at the last meeting of the Berlin District Gas Association, Herr Schaefer, of Dessau, remarked that statistics furnished by German insurance companies did not confirm the thought that fire risks had been diminished by substituting electric for gas lighting.

In 1883 the electricians were in high hopes that the "alleged immunity from fire risk" of electric lighting would enable them to get reduced rates from the insurance companies. Such reduction of rates was often spoken of, but never came to pass. In 1896 the Hanover Fire Insurance Company told their shareholders that the question of the comparative safety of electric lighting was by no means settled, but that clearly there could be no reduction of rates. In 1898 the German Association of Fire Insurance Companies memorialized the Imperial Chancellor, requesting him to put electrical installations under police control and supervision; and a year after they remarked on the considerable increase in the number of fires due to electricity. In 1901 the Dessau Gas Company inquired whether they could get reduced rates on replacing gas by electricity, and were told that under no circumstances could there be a reduction, but that there might be an increase unless the installation was put up and maintained according to the regulations of the Fire Insurance Association.

In Germany there are two groups of insurance companies—18 private companies and 36 public associations. Both of these groups have published some statistics. Those of the former group appeared in Neumann's "Vereinsblatt fur Deutsches Versicherungswesen"; those of the latter group in the year book of the "Mitteilungen fur die offentlichen Feuerversicherungsanstalten." The author has summarized these statistics in diagrams, which show that the fires caused by gas and electricity fall far below those due to explosion of spirit or petroleum, or to children playing with matches. In 1899 and 1900, children with matches caused 1,125 and 963 fires in the purview of the 18 private companies; explosions of mineral oil caused 1,583 and 1,627; electric failures caused 204 and 226; explosions of spirit (alcohol), 207 and 207; and gas explosions 158 and 199. Under gas explosions are reckoned acetylene, producer gas, oil gas and the like, as well as coal gas.

Unfortunately, these statistics of the 18 private companies were not continued in this form beyond the year 1900. The fires due to electrical causes in the years 1901-4 amounted, however, to 265, 238, 248 and 278 absolutely almost constant; but relatively to the increase in electric lighting, these figures show a diminution. In 1903 there were 98, in 194 there were 208 fires due to explosions of alcohol—an enormous number, having regard to the small extent to which spirit has come into use. Petroleum lamps, matches, and the children who play with them, seem more in need of police supervision than electric installations do.

As to the 36 public insurance associations the results are much the same. Their data show the following:

	1897.	1898.	1899.	1900.	1901.
Total number of fires....	16,950	17,133	18,947	18,316	19,941
Whereof caused by—					
Children and matches..	967	1,012	1,128	1,080	959
Petroleum explosions..	367	362	414	354	415
Gas explosions	67	68	65	57	87
Electricity	22	25	51	42	73

During the 5 years, 5.64 per cent. of all the fires were occasioned by children playing with matches, 2.09 by petroleum explosions, 0.38 per cent. by gas explosions, 0.23 by electricity. The number of fires due to electricity increased much more rapidly, in comparison with those due to gas, than the relative expansions of electric and gas lighting would indicate. Here, also, "gas" included acetylene, etc., as well as coal gas. It is worthy of note that both gas and electricity were responsible for a relatively small number of fires.

The statistics of the Berlin fire department show that the number of fires have by no means kept pace with the expansion of the two systems; that out of every 900 electric services there is one fire per annum, while with gas there is only one fire per 8,000 services. In Berlin last year (1904-5) there were 12,788 fires, of which 30 were due to gas, 25 to electricity, 77 to children, 18 to petroleum.

During the 5 years, 1900-1 to 1904-5, there were 9 fires in electric works in Berlin; 1 in a gas works; 29 fires in electric works all over Germany. During the same period there were 66 fires in Berlin theaters, of which 21 were due to electricity; once to four times in almost every Berlin theater; and it was only the continuous supervision which prevented these becoming dangerous. During the same period 32 shops were set on fire by electricity.

NATIONAL BOARD OF FIRE UNDERWRITERS' QUARTERLY REPORT.

The Electrical Bureau of the National Board of Fire Underwriters have issued their quarterly Fire Report for quarter ending January 1st, 1907.

While electric equipment, if properly installed by responsible parties, offers no greater hazard to property than other systems of lighting and power purposes, a lax observance of the necessary precautions and specifications of the National Electrical Code, does materially increase the danger from fire, as shown by several reports of electrical fires, as taken from the above-mentioned report.

Circuits Overloaded.—Fire originated from a short circuit above a metal ceiling and spread through the open partition into the attic above. The original electric installation in this building was good, but trouble was caused by overloading the circuits. The 16 candle power lamps for which the circuits were planned were replaced by 140 candle power lights. The branch circuits were fused to 30 amperes and the service cut-out was fused with strips of lead wire No. 3 B. & S. gauge. $8,000 damage.

Ground on Gas Pipe.—Wires leading from basement through a partition wall to side bracket worked loose and end of wire came in contact with unused gas pipe, causing flash sufficient to ignite insulation of wire. Flames spead in partition until fire was beyond control. Installation about fifteen years old and recently replaced in part by new work. Damage, $10,000.

Incandescent Lamp Starts a Fire.—A window dresser was called away from his work and left a lighted 32 candle power lamp resting against a wax figure in the show window. The lamp did not have a wire guard. Heat from lamp set fire to figure. Loss, $1,500.

Untaped Joints in Wooden Moulding.—A fire was started by a short circuit in wood moulding carrying branch lighting circuit, caused by water leaking through from floor above. Taps for drop cord where short occurred were not soldered or taped. Damage slight.

No Emergency Switch in Line.—Engineer in large station supplying current to several synchronous motors in a cotton mill cut off power for a few minutes and then without warning put it on again. Motors dropped speed and were caught out of phase when circuit was made alive again. The result was the burning out of several armature coils. The attendant noticed trouble and opened the disconnecting switch to save the motors. Short circuit took place across the switch and the heat became so intense that the attendant was driven out of the room. There were no emergency switches in the line and it was ten minutes before the power station could be notified to cut off the power again In the meantime the switchboard, consisting of several panels, and the contents of the room were destroyed. Loss $5,028.

Tacks Make Short Circuit.—In the parlor of a hotel having a direct current isolated plant there were two arc lamps temporarily hung, and the connection to same was made by heavy cotton covered wires hidden on top of a picture moulding. Preparatory to a political meeting the

decorator tacked bunting, etc., to the moulding and evidently the tacks penetrated wire coverings, causing a short circuit when current was turned on. Damage $50.

Jumped His Fuses.—Electrician in charge of a large plant had orders to keep the lights going at all hazards. The main cut-outs were in a wood cabinet hung to a heavy wood post in center of a large room three feet under the wood roof. The main leads were open and strung on roof beams, and carried 110 volt alternating current circuit. The load was too great for the installation. One fuse blew and started fire and burned off service wire of fuse terminal. Afterwards, not being able to hold his fuses, the electrician put jumpers over them, but did not attempt to make good joints. One jumper was made up of 2 "0000" cables taped but not soldered. The other jumper was a single cable like the first, joints bare and unsoldered. The heat developed again set fire to the cabinet which was lined with two thicknesses of ⅛-inch asbestos. Loss confined to cabinet.

Unused Service Wires not Cut Off.—A broken cleat allowed one wire of unused service system, which had not been cut off outside of building to come in contact with woodwork which was water-soaked. Ground through the wet wood to water pipe, set fire to insulation and wood and also made the water pipes alive, resulting in serious injuries from shocks to several inmates of the house. Prompt discovery prevented large fire loss.

Another Flat Iron Fire.—Current was left on in an electric smoothing iron in a large tailoring establishment. The iron stand became so hot that it charred the wooden table on which it was resting, causing considerable smoke, which drew the proprietor's attention thereto. Damage slight.

Ground on Gas Meter.—Fire was caused in a large furniture store by an employe of the light and power company in testing a meter. He crossed the knife blades on service switch with small tool, bringing the tool in contact with a gas meter which was located too near switch. The arc burned a hole in the meter and set fire to the escaping gas. The fire communicated to paper and canvas ceiling. Loss, $100.

Defective Car Heater Causes Large Loss.—Heat was turned on in a car stored at the terminal of elevated road. The car was equipped with old style heaters. The heaters failed by wires of the heater coils breaking. Arc set fire to woodwork of car. Fire spread and eight cars were damaged. Loss, $10,000.

Ground on Metal Lathing.—Wires feeding a bracket fixture in a room of a large hotel ran up behind expanded metal lathing on the wall. Wires were not properly insulated and burned an arc between wall and metal until it burned through the plaster and drapery. But for the fact that the burn-out occurred on a brick wall and in the day time, serious loss would have resulted.

Defective Arc Lamp.—Carbon holders in arc lamp failed to work. Coils in lamp became overheated, setting fire to insulation of wire. Fire communicated to wood ceiling. Loss, $15.00.

Tailors' Flat Iron.—Tailoring flat iron left turned on all night in a six-story department store. Iron was resting on an all iron stand. Indicating switch and lamp in multiple were installed. The heat from the iron communicated to the stand, which in time became so hot as to ignite dry goods on table on which the iron stood. Fire also traveled along circuit wires. Automatic sprinkler system operated and put out fire. Loss, $2,000.

Summary of Reports Received During the Quarter.

Sixteen fires have been reported as caused by high tension lines falling across telephone and lighting circuits. Losses given amount to $966.

Grounding of lighting and motor circuits have been responsible for eighteen fires. Losses as reported, $11,240.

Short circuits of interior wiring caused thirty fires. Losses aggregate $19,500.

Moving picture machines, five fires, $1,400.

Electric motors, twelve fires, $5,540.

Fuses blowing caused six fires.

Electric flat irons, four fires, $7,698.

Lightning, nine fires, $3,328.

Car heaters, three fires, losses, $11,000.

Incandescent and arc lamps have been responsible for nine fires. Losses as given, $1,535.

Three tree fires are reported.

Eighteen accidents to persons are reported, two of these being fatal.

All of the fires summarized above have been reported to this bureau by inspectors.

The losses so reported aggregate $62,207, but it should not be assumed that these figures represent the entire fire loss due to electrical causes.

In addition, fifty-three accounts of supposed electrical fires have been received, in which the causes were given as "crossed wires," "defective wiring," etc. Of these fires no more definite information has been obtainable. The aggregate loss on these fires was $572,603.

Fifteen other fires at first reported as due to electricity, upon further reliable investigation by inspectors, have been found due to other causes. The losses on these fires amount to $112,200.

RUBBER.

One of the most important questions demanding the attention of the electrical engineer at the present time is that concerning the supply of india rubber, or caoutchouc. For while the demand for this material has been steady, the supply has at times proved inadequate, owing to various causes, hence the interest with which the cultivation and production of rubber is regarded. Happily ,there is little or no reason to fear a scarcity of supply in the near future, judging from the satisfactory reports that reach us from various producing centres. According to a report sent by Mr. D. F. Wilber, the American Consul-General at Singapore, to the Washington Bureau of Manufactures, there is a great boom in the planting of rubber throughout the Malay Peninsula, in the Federated Malay States, and Johore. It has proved a lucrative business in many instances for promotors, who have floated company after company until at the present time there are eighteen rubber companies owning plantations in the above countries, most of them being organized during 1904, 1905 and 1906. In the native States of Selangor, Negri, Sembilan, and Perak, out of a total of 134,664 acres, 21,266 are now in rubber. It is estimated that a return of at least half a pound per tree could be secured from five-year-old trees, but calculations are not made on anything until the sixth year, when it is certain that rubber planted on good alluvial land will yield at least one pound per tree. Several millions of Para rubber trees have been planted in the Federated Malay States during the past five years,and experimental tapping of these older trees has proved satisfactory. As much as twelve pounds of rubber has been extracted in two years from a tree thirteen years old in the Penang gardens without any injury resulting, although the soil in that particular place is not considered favorable for rubber planting. There is quite an amount of the lower-grade rubber produced in this section, but planters are now paying more attention to the better grades, and the next few years will show a large increase in the output of Para rubber. The Malay Peninsula seems to be an extremely fertile field for the production of rubber, for it has been estimated that within the next seven years the total exports of cultivated indiarubber from Ceylon and the Federated Malay States will reach between ten and fifteen million pounds annually, and that after fifteen years they may exceed the exports of the so-called wild rubber from Brazil.

ANNUAL PRODUCTION OF OIL AND WATER GAS.

Returns were received from 477 oil and water-gas producing companies, and these show that the total production of water gas in 1905 was 82,959,228,504 cubic ft. Of this quantity 5,547,203,913 cubic feet, or 6.7 per cent., were lost by leakage, etc., leaving 77,412,024,591 cubic feet as the net production obtained and sold. As the quantity of gas made and sold at coal-gas and by-product coke-oven works was 40,454,215,132 cubic feet, it appears that the consumption of water gas and gas made from crude oil was nearly twice as much as that made from coal. It also appears that while the average price of coal gas in 1905 was 81.4 cents per 1,000 cubic feet, that of oil and water-gas combined was a fraction of a cent in excess of $1.00 per 1,000 cubic feet. Still further comparison shows that whereas 66 per cent. of the production of coal gas was sold as illuminating gas, 77 per cent. of the combined production of oil and water-gas was used for this purpose.

GREATEST POWER HOUSE EVER BUILT.

Final contracts have been awarded and ground is about to be broken for the construction of the remaining half of the Brooklyn Rapid Transit's Williamsburg power station. The dimensions of the new half will be about 200 by 130 feet, and, like its forerunner it will rise to the full height of a ten-story building. Together with the half already completed and now in partial use the new addition will complete the company's plans and make a power station far larger than any ever before conceived or constructed, rising to a great height above narrow Kent avenue, and covering a tract 200 by 260 feet and costing the enormous sum of $5,500,000.

The new power house adjoins the south wall of the old eastern station, built by the Brooklyn City Railroad but a few years ago, equipped with Corliss engines—now almost an obsolete type—and regarded as about the finest type of power house construction possible. Today it is but a toy compared with its big new neighbor, equipped with modern turbine engines of tremendous horsepower and burning more than 2,000 tons of coal every twenty-four hours to keep the engines going. The two power houses—old and new—occupy a frontage of 373 feet on Kent avenue and extend back to the East River, which gives unexcelled water transportation for fuel and for ashes.

The first half of the Williamsburg station was built on the Kent avenue side of the property. The second half will be built to the west and close up to the company's dockage. The temporary west wall of the present structure will be torn out and the great engine-room, extending clear from floor to roof, will be doubled in size. Similarly the two boiler rooms, the one imposed above the other, will be increased in dimensions and thirty-six new boilers of the improved water-tube type will be added to the thirty-six similar boilers already in service. Nearly a week's supply of coal can be kept in the great bunkers of the attic, which will be increased in ratio with the rest of the structure.

The interior of the Williamsburg power station has been a marvel to those privileged to see it. The old idea of any structure devoted to the mere housing of machinery has been reversed by the B. R. T., which believes that in giving Brooklyn the world's largest and finest power station, details should be in keeping with the rest of the project. So details have not been neglected. Bronze clustre lamps adorn the ornate entrance to the power station on Kent avenue, the entire facade has been made an attractive architectural conception in limestone and fancy brick, the entrance ways are tiled and walled in marble, while the interior of the engine room, the largest single room in the city, has been made radiant by the use of white porcelain lining brick with a plentitude of decoration in colored tile and terra-cotta. Illumination is furnished by bronze bracket lights and long strings of incandescent lamps fastened to the roof girders.

Four new turbines, each of 15,000 horsepower, have been ordered for the new part of the power station, and already are under construction in the Pittsburg shops of the Westinghouse company. They are the largest steam engines or electrical generators ever built, and like the big power house itself, mark a new standard and a new era in electric railroad construction. They will be an extensive addition to the engine equipment of the present half, which comprises four 10,000 horsepower turbo units and one 7,500 horsepower turbine. Three of these are already in effective service, while the fourth goes into operation within a very few weeks.

The Williamsburg power station will easily develop 100,000 horsepower, which can be increased under pressure and with little trouble to 150,000 horsepower. The immensity of such power can be better realized when it is fully understood that on its heaviest days the demands on the power houses by the whole B. R. T. system—surface and elevated—does not exceed 120,000 horsepower. It can readily be seen that the new power house makes ample provision for future growth of the system, and that in case of the almost impossible—the complete breakdown of all the power stations of the system—Third street, Eastern, etc.—the Williamsburg giant could move the 3,000 cars of the B. R. T. with scarce an effort.

Work is to be pushed with all possible speed toward completing the new station, and it is anticipated by the company that twelve months will see its nine great units being operated and the new power house being tested to its highest efficiency.

ANNOUNCEMENT OF CIVIL SERVICE COMMISSION EXAMINATIONS.

Irrigation manager in the office of Experiment Stations, Department of Agriculture, salaries of $1,800 to $2,500 per annum. Second-class or Assistant Steam Engineer in Courthouse and Post Office building, Salt Lake City, Utah, salary, $900 per annum. Assistant Assayer in the United States Assay Office at Charlotte, N. C., salary $1,250 per annum. Irrigation Farmer in the office of Experiment Stations, Department of Agriculture, at salaries of $720-$1,200 per annum. Supervising Drainage Engineer in the office of Experiment Stations, Department of Agriculture at salaries of $2,000-$2,500 per annum. One draftsman, San Francisco, Cal., $1,400 per annum. One draftsman, San Francisco, Cal., $4.00 per diem. Two copyist-draftsman, Phoenix, Ariz., $4.00 per diem each. One draftsman and three copyist-draftsman, Reno, Nev., $4.00 per diem each. One draftsman, Bismark, N. Dak., $1,400 per annum.

SAN FRANCISCO WATER SUPPLY.

The Supervisors of San Francisco have adopted a resolution calling on City Engineer Woodward and his former assistant, John R. Price, to continue their investigation of the water supply proposed to be furnished the city by the Bay Cities Water Co. from the American and Cosumnes rivers, the initial cost of which is to be $10,500,000. The two investigators are expressly directed to go to the Bay Cities Water Co. for data. The resolution bids the engineers "demand of the proponents of the American-Cosumnes Water Supply Co. the production for their use in the preparation of their report of all engineering data, surveys, etc., in their possession," bearing on the matter in hand. From this data the engineers are requested to inform the Board if the city could be assured of a continuous and immediate supply of 75,000,000 gallons daily, also as to the horsepower capable of being developed, the character of the existing works and the possibilities of future development of the system. The resolution ends as follows: "The object of the Board is to determine whether or not the supply offered meets the requirements of the city for a municipal water supply, and if it be so found, then the Board will investigate and determine upon the question of titles and of the price of said supply; and if the adequacy of said supply, and the titles thereto, and the price thereof shall be found satisfactory, then the Board will submit to the people of the city, at the earliest practicable time, the proposition for a municipal water supply."

The JOURNAL OF ELECTRICITY
POWER AND GAS
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The Engineers' Architects' and Builders' News

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Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," with which is incorporated "The Engineers', Architects' and Builders' News."
Entered as second-class matter at the San Francisco Post Office, August 15, 1899.
Entered as "The Electrical Journal," July, 1895.
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VOL. XVIII FEB. 9, 1907 No. 6

EDITORIAL.

The Builder and the Contractor

The greatest single piece of construction work of modern times is the digging of the Panama Canal. The builder, the United States Government, has resources probably as large as any builder in the world. The work involves all features usually found in such enterprises, including financial, labor, sanitary, and commissary matters. The federal government has done in the past, and is at the present time doing under the direction of its numerous departments, many kinds of construction work without the use of a general contractor, the supervision and labor being furnished solely and paid directly by the government. Notwithstanding this fact, the Panama Canal is to be built by contract under the plan generally known as the percentage basis, wherein the contractor is paid a certain fixed fraction of the total cost of the entire work, to which may be added additional amounts or bonuses, depending upon the saving in time and money resulting from the efforts and ability of the contractor in reducing the period of time required for the actual construction and the actual total cost of the work to the builder.

The decision of the government to have all the work done by contract has received the unqualified approval of the men, both engineers and laymen, who from their knowledge and experience are best fitted to express an opinion in the matter. It must be said with regret that politics, not good politics, but bad—yes the worst politics—has too many times entered into government work of every character. Every American citizen has just cause to be proud of his country, a great many have good reason to respect the government of the State in which they live, and a few—a very few—can honestly say they believe in the honesty and integrity of their city governments. And so, if by letting the contract to build the Panama Canal the federal government can completely and forever prevent unscrupulous politicians from increasing the cost of the work, in order to favor some undeserving rascals, or delay the time of completion in the interests of any class of citizens or corporations, an advance will certainly be made which will be welcomed by every loyal American.

In proceeding with the work as above outlined, the officials at Washington are but following the example set by the most successful private corporations, both large and small. The enormous expenditures required in building and equipping large transportation systems and also electric, gas and power installations, have placed upon those in charge of such work a responsibility not easily defined. And it is a fact that the men are few who have had the experience and training, not mentioning the personality, required to wisely direct such construction work, so that it will be built at minimum cost, consistent with the best workmanship and the smallest amount of time required for the work.

The men who are best fitted to prosecute, direct, and supervise construction work of this magnitude are found today in such a position that their proper remuneration can more readily be provided by a private contracting firm than by the federal government.

TRADE CATALOGUES.

The Joseph Dixon Crucible Co., Jersey City, N. J., have started out the New Year with a bright and cheerful issue of their "Graphite." Although devoted almost entirely to their graphite productions it is full of interesting reading matter.

Kerr Turbine Co., in their Bulletin No. 2, give descriptions of their steam turbine and steam turbine blowers. They also show a number of other applications of the steam turbine to general use.

Requests for this catalogue should be sent to Kerr Turbine Co., Wellesville, New York.

The India Rubber and Gutta Percha Insulating Co. have issued a new price list for Habirshaw wires and cables with addition tables for extra braids, cotton or paper wrapping, Pacific Coast prices, 30 per cent Para compound, flexibles and lead covering.

This pamphlet will be of interest to the trade, as it does away with the necessity of the frequent issue of leaflets giving the varying changes in the price of wire due to the fluctuating copper market. By means of this pamphlet the trade can ascertain the price of wire if they know the market price per pound on copper bars.

The book also contains a synopsis of rules and a comparison of copper wire gauges, etc.

The California Electrical Works are the Pacific Coast Agents for this company.

The Electric Storage Battery Company, of Philadelphia, has recently issued a folder describing the application of "Chloride Accumulators" and "Exide" batteries to stationary gas or gasoline engines. The folder illustrates the system of battery ignition with these cells, both in stationary form, where charging current is available, and in portable form where it is necessary to carry the batteries to a convenient charging source.

Illustrations, dimensions, weights, capacities and prices of the two-plate types of "Chloride Accumulator" and of the "Exide" Sparking Batteries are given with a diagram of connections, and a concise explanation is included showing the method of determining the necessary resistance for cutting down the line voltage from an ordinary lighting circuit.

The folder will be found useful to all operators of stationary engines, and will be forwarded from any of the sales offices of the company, upon request.

The Locke Insulator Mfg. Co. The Insulator Book, 1907 edition.—The splendid finish and arrangement of this catalogue and the value of its contents to the engineering fraternity will, beyond doubt, create a great demand for it.

The compilers state that every endeavor has been made to present only such material and data as has withstood the test of actual service, and great care and conservatism has been used in recommendations.

Several pages are devoted to testing, with illustrations and drawings, explaining methods. A table for sparking distances is also given. Standard designs for pole top construction, together with excellent cuts of the various types of insulators manufactured, complete the sixty pages of the book.

Allis-Chalmers Co., Electrical Department. This Bulletin on the subject of the "H. Ward Leonard System of Multiple Control for Variable Speed Motors," is reprinted from Bulletin No. 1044.

The matter contained therein is of interest throughout, especially that part devoted to a "comparison of variable speed systems." This shows by means of tables and curves the efficiency of the various systems.

(Allis-Chalmers Company). Bulletin No. 1403, entitled "The Hancock Jig" recently reprinted. This company states that their mining department has in its possession considerable data showing the economies effected by the use of this Jig at a large number of ore reduction centers in the United States, Canada and Mexico, extracts from which will be published in a subsequent bulletin. No. 1403, however, contains sufficient matter to indicate the saving which has attended the introduction of the publication, especially at this time. You rae doubtless in already read it will undoubtedly find the publications of value.

OUR FOREIGN LETTER.

Arriving in Berlin yesterday, from a Christmas trip to Italy, was pleased to find the first three copies of your estimable publication on my desk. Am pleased and surprised at the excellence of th epublication, especially at this time. You are doubtless in receipt of more descriptive matter than you can use in relation to these foreign power plants, and as I am not in a position to get detailed descriptions so much as a broad study of them all, and their results, will endeavor to give you the latter.

Would suggest that you keep in touch with the Deutscher paper, "Die Turbinie," as it contains all the latest of this country in steam, gas, and compressor turbines. If you want any German translation done, beg to refer you to a Miss Duden, an employe of the "City of Paris," who reads and writes English and German equally well, and whose rates are very reasonable.

The German technical papers are very fine, but only about twelve in mechanical engineering are worth mentioning. Their books are good and very up to date; it is the practice to issue quite an exhaustive pamphlet for a few cents, on a subject that has only just come before the public. For instance, a new steel is advertised by a firm; in a few weeks you can buy the pamphlet of some professor, who has made a complete analysis of the steel, and knows approximately how it is manufactured.

The great demand for American machine tools here, increases steadily, and the American firms are either very indifferent, or they cannot handle the business, for all the German firms are simply howling for American tools, which they cannot get. Acme automatics and Niles heavy machinery are attracting a lot of attention just now, but every good make is being used.

The fine performance of the turbine steamer "Princess Elizabeth" is attracting considerable attention. She is 347 feet long, has three turbines, three screws, and has been running over a year.

Much data and records of tests is being published on centrifugal pumps; makers now being able to produce a pump that competes commercially with the best types of reciprocating pumps. A very fine paper at the "Vereines Deutscher Ingeneure," by Dr. H. Hoffman, describes the machinery in use in German mines, and mountain work. These mines are, as a rule, splendidly equipped, including the highest types of express pumps; high duty centrifugals, driven by huge slow speed induction motors, direct connected in all cases. There are also shown direct connected electric hoist works, gas engine power stations, steel furnaces, structural steel galleries, bridges, steel ore cars, electric locomotives, steel elevators, and an electric hydraulic pressure plant. The machinery is of a higher class, and greater efficiency than is used in California generally.

A large structural steel mast crane has just been built by a Berlin firm; it is some 140 feet tall, with 75 feet radius, and lifts about five tons at any point within its circle.

The discussion of gyroscopic wheels on ship board, which was in the American papers so much last year, is now being taken up by German authorities, and analyzed, with ponderous equations, and heaps of letters and radicals.

It may please some of our readers to know that rotary engines are invented here with the same continuous regularity, and patented, as in America. Some have myriads of moving parts, others are as naked and simple as Adam.

What at home we call a plain traction, thrashing, or portable engine, over here is portable; but, it is, as made by R. Wolf, cross compound, condensing, with feed water heater, and super heater.

The best type of level used for accurate municipal work, is about the size of a small cannon, and is carried in a carriage, other instruments in proportion.

Paul Heuer, Dresden-A-7, manufactures a reduction speed changer, which he claims will give any ratio between 1-4 to 1-50, and it looks very neat from the outside. One firm has been getting splendid results in efficiency with a centrifugal pump having only three blades.

A great many bucket and chain dredges are being built for harbor work, and river work. They are very large, and with steel hulls, and steam propelling mechanism, and cost as much and more than a well equipped of the same tonnage.

The sterobograph has been attracting a good deal of attention. It is an instrument which indicates and registers the variations, angularly in the rotation of an engine or other shaft. All papers have the usual profound and theoretical articles on various subjects; but in many cases a man could build and try the idea while trying to read one of them. Yours truly,

E. N. PERCY.

UNITED STATES CIVIL SERVICE COMMISSION EXAMINATIONS.

Geogolist, Philippine Service, salary, $2,000 per annum. Apprentice Topographic Draftsman in the Coast and Geodetic Survey, salary, $700 per annum. Civil Engineer Student in the office of Public Roads, Department of Agriculture, salary, $600 per annum.

EXPOSITION OF SAFETY DEVICES AND INDUSTRIAL HYGIENE.

Governor Hughes of New York is a central figure in a new movement that is outside of statesmanship, and yet, in the broader, better sense, is statecraft in a high degree. Sparing the lives of tens of thousands of men and women each year is this new movement's aim. In a great banquet at the Waldorf-Astoria on the evening of January 28th, the famous Chief Executive of the Empire State made the leading speech. His words were the first definite step towards the establishing of an American Museum of Safety.

Several hundred men of prominence attended this dinner—manufacturers, merchants, publicists, society men, capitalists, editors of technical journals. Men who have the handling of men were its guests. The text of the night was a single idea—America's heedless waste of her workingmen, the fact that this country's mechanical triumphs are being overshadowed by the danger to life in the wonderful advance.

The new movement for some sort of security for the American workman as he bends over his machines is on a firm foundation. The day after the Waldorf-Astoria banquet, Chapter II will be opened. In a wing of the huge American Museum of Natural History, New York, through the instrumentality of Morris K. Jessup, president of the New York Chamber of Commerce, an "Exposition of Safety Devices and Industrial Hygiene" will be opened, with exhibits, photographs and models for protecting the lives of working people, gathered in this country and abroad. The exhibit will last two weeks at least, will be free to every one, will keep open Sundays and evenings, and a feature of it will be many illustrated lectures given by Dr. William H. Tolman, director of the American Institute of Social Service, under whose auspices all of this is being done.

57,000 Killed Each Year.

According to the census, 57,513 persons in the United States suffered violent deaths in 1900. Where we have exact figures for comparison they show more than twice as many accidents in this country, relatively, as in Europe. A large proportion of them needlessly and heedlessly, while half a million more were injured.

There, Museums of Security are in active existence, and make known, popularize and force into use devices for guarding machinery.

Even in Russia such a museum exists. A fine Museum of Security has been established in Moscow, and guards the Russian working man. "We talk," says Dr. Strong, "of the barbarities of war, and do well to establish our peace societies. Is it not time to do something to stop the increasing barbarities of peace?"

But what after all, is a "Museum of Security or Safety?" However effective abroad it is a completely new idea for this country, and one that "boss" and workmen, generally speaking, know nothing of. What does a Museum of Security do; how does it stop accidents? Why should the great magnate, Henry Phipps, write recently to the American Institute of Social Service and say:

"I am pleased to learn that you are to have an Exposition of Safety Devices and Industrial Hygiene. It is a matter I have been thinking of a good deal, and I intended writing one of the leading railway presidents in a company in which I have an interest; but your method of going about it is much better, and I am glad to inclose you my check for $500."

In an article in a recent number of the Century Magazine, Dr. Tolman described interestingly just what a "Museum of Security" was, what it had already accomplished abroad:

What Such a Museum Is.

"The idea of a Museum of Security excites curiosity. People ask, 'What's that?' It is not surprising that there should be general ignorance on this subject, because such institutions are of recent origin, the first having been opened in Amsterdam in 1893, in charge of a mechanical engineer, who is responsible for the supervision of machinery and its explanation.

"Among the curious sights in Amsterdam there is one that will escape the tourist unless his attention is particularly directed to it. Leaving the royal palace behind him, cutting through the narrow streets, crossing the numerous bridges of the Venice of the North, and making his way down a side canal, he comes upon the "Museum van Voorwerpen ter Voorkoming van Ongelukken en Ziekten in Fabriken en Werkplaatsen.' Reduced to its lowest terms, this means in English the 'Amsterdam Museum of Security.'

"This building contains a permanent exposition of apparatus and devices for the prevention of accidents in factories and workshops, so that manufacturers and all other employers of labor may see in actual operation the safety devices that guard the lives and limbs of their workers. This museum owed its origin to the Association for the Development of Manual Training and Handwork in Holland. The labor inspectors of Holland find that the museum is of the greatest service to them, because it meets every objection on the part of a superintendent that the safety device in question will interfere with the proper operation of his machinery.

"In 1887 an important exposition of devices for the prevention of accidents to laborers was held in Berlin. An effort to preserve the valuable documents and other exhibits as a collection did not succeed at that time, chiefly through the failure of the government to co-operate. But in 1900 an appropriation of $142,000 was made by the Reichstag for the creation of a museum of security. The Reichstag also appropriated $75,000 in 1901 and $43,750 in 1902. For the maintenance of the museum, which is in Charlottenburg, an appropriation of $7,500 was made in 1902 and $10,000 in 1903.

Importance of Industrial Hygiene.

"As its name indicates, the Museum of Security aims to become a permanent exposition not only of devices for the prevention of accidents to laborers, but of the best suggestions originated by any person or institution to help workmen in any way. It is really divided into two great sections, one comprising all that has to do with the prevention of accidents in the various branches of industry and the other comprising social and industrial hygiene.

"'What was your plan for collecting your machines and models?' I asked Dr. Albrecht, the executive director in Charlottenburg.

"'In the first place,' he said, 'we appealed to constructors and inventors, offering a place in the museum where such methods and devices could be brought to public attention, in this way enlisting the support of all classes. We reserve in support of alP,26,nY shrdcmfwypshrdlcmfwycmfwycmfwyp every instance, however, the right to refuse any specimen or plan not deemed useful. The exhibits are temporary, and at any time may be replaced by others that are better. The museum is already so full that the question of enlarging it has been brought up.'

"How do you guard against the admission of machines or devices that are unsuitable?" I asked him.

"'For that,' replied the doctor, 'we have a jury of twenty-eight experts—engineers, factory inspectors, technicians and of four trade representatives, namely, a brewer, a cabinet maker, a worker in metals and a worker in textiles. Any device that is passed upon by this jury is accepted as a loan by the museum for one year, with the privilege of its renewal. In this way we keep the exhibits thoroughly up to date, replacing old models by those that are new and more highly perfected.'"

Details of the Exhibit.

The coming New York Exposition, opening on the morning of January 29, will consist as much as possible of "live exhibits," that is, machines or devices in operation; models

of acutal or reduced size, and photographs. Wood and metal-working machinery; stamping, grinding and polishing machines;presses; textiles; the building trades; safeguarded elevators, windlasses, cranes and hoisting machinery; transportation security by sea and land; safety lamps and explosives; quarrying, agricultural and chemical industries; safety from fire.

The Section of Industrial Hygiene will include, improved dwellings; first aid to the injured; prevention of tuberculosis and other dread disease harmful to the life of workmen; respirators and devices for supplying and maintaining pure air and industrial betterment.

To each exhibitor a diploma will be presented, designed by one of the foremost artists of America. A handsome medal has been made. Its obverse shows a graceful figure of a woman against a background of machinery, and the legend is "Security for Humanity's Sake." On the reverse is, in panel form, "First International Exposition of Safety Devices and Industrial Hygiene by the American Institute of Social Service."

Carroll D. Wright, now president of Clark University, will represent the President of the United States at the banquet and will speak. "The Institute's honorary vice-presidents for this work are Grover Cleveland, first vice-president; Frank W. Higgins, ex-Governor of New York; Curtis Guild, Jr., Governor of Massachusetts; E. C. Stokes, Governor of New Jersey; Henry Roberts, ex-Governor of Connecticut; C. P. Neill, U. S. Department of Labor, Washington, D. C.; T. P. Sherman, Labor Committee of the State of New York; H. C. Bumpus, director American Museum of Natural History.

Women's Committee—Mrs. Douglas Robinson, honorary chairman; Mrs. W. Bayard Cutting, Mrs. Charles E. Hughes, Mrs. Seth Low, Mrs. George B. McClellan, Mrs. J. Pierpont Morgan, Mrs. Levi P. Morgan, Mrs. William Jay Schieffelin, Mrs. Lorillard Spencer, Mrs. I. N. Phelps Stokes, Mrs. Joseph H. Choate, Mrs. Grover Cleveland.

TANTALUM ORES.

Tantalum lamps are manufactured in small quantities, compared with carbon-filament lamps, chiefly because of the rare occurrence of the mineral. The great improvements which have recently been made in the tantalum lamp, and the almost common belief that the ordinary incandescent lamp must be superseded by a metallic-filament lamp, attract the attention of electrical engineers to the question concerning the production of minerals, and any new workings which are likely to increase the production of these minerals may have an important bearing upon the electrical industry. Thus, the discovery of tantalum ores in West Australia is a matter of much importance. The "Times Financial and Commercial Supplement" prints an interesting statement from a correspondent at Kalgurli, West Australia, dealing with the financial aspect of the question. Tantalum was first discovered in this State in 1894, when the rare mineral stibiotantalite (tantalate and niobate and antimony) was identified in the tin washes of the Greenbushes tinfield, near Bunbury. In 1900 tantalite (tantalate of iron) was discovered in the concentrates at the same place, and shortly afterwards large deposits of manganotantalite (niobate an tantalate of manganese) were found on the Wodgina tinfield. Wodgina is situated on the Pilbara goldfield, about 160 miles inland from Port Headland. The introduction of the Siemens and Halske tantalum light furnished a market for the mineral, and in 1905 over 70 tons, valued at £8,925, were exported. This ore contains from 68 to 70 per cent. of metallic tantalum. The bulk of these shipments were obtained by "dry-blowing," the alluvial consisting of decomposed pegmatite from the tantalum lodes. The mineral occurs in lumps varying in weight from a few grains to blocks of thirty-seven pounds weight. The market fell away towards the end of the year, and at present there is no official market obtainable for tantalum ores. Although it is popularly supposed that the only use to which tantalum has been placed is in the manufacture of filaments for electric lights, this is by no means the case, for tantalum possesses properties which render it an important factor in steel alloys. Tantalum is a hard grey metal, somewhat heavier than iron, and is markedly ductible. At the same time when hammered it becomes harder than the hardest steel, and has even been suggested as a substitute for diamonds in diamond drilling. It is not acted upon by air except at high temperatures, and is unaffected by all acids save hydrofluoric. It has been shown to alloy well with steel, and the alloys possess not only great hardness, but are also very tough. Only a very small percentage of tantalum is required in these alloys. The correspondent believes that Krupps are experimenting largely in this matter, and that they, or some other German firm, are making every effort to "corner" the Wodgina fields. He adds: "The present strangulation of the market is a means to that end. The tantalum mines are few in number, and the control of fully 70 per cent. of the ore in sight is vested in one company. There is no doubt that this control could be transferred to German hands tomorrow. It is simply a question of price. The presence of niobium in the mangano tantalite is no longer a prohibitive factor, as recent research has shown that the niobium may be completely separated. As yet the lode has not been proved in depth, as the surface deposits have more than sufficed for all present requirements." He concludes that the present drop in the price of tantalum is simply a market move designed to prelude the buying up of the leases in the Wodgina.

HARRIMAN AND THE SOUTHERN PACIFIC.

The Los Angeles "Examiner" prints the following story: Instead of declaring a dividend for the stockholders of the Southern Pacific Railroad in 1905, President E. H. Harriman ordered an appropriation of $5,000,000 for the purpose of electrifying the western division of the system, which is the old narrow-gauge route from Oakland by the way of Haywards and the Niles Canyon, through Alviso and San Jose ot Santa Cruz. In addition to this, $800,000 was appropriated to tunnel the Potrero of South San Francisco, and another $1,000,000 was taken to build a bridge across the Bay of San Francisco at Dumbarton Point. All of this work is now under way, and it is the starting point of the gigantic enterprise by which Mr. Harriman proposes to combine the electric road and power companies of Southern California and finally to give the Southern Pacific Company an electric line from Los Angeles to San Francisco.

To accomplish this Mr. Harriman, in addition to changing his narrow-gauge line to Santa Cruz into an electric line, secured control of the Santa Cruz & Watsonville Railroad, and the Watsonville, Salinas & Spreckles Railroad Company, and consequently came into ownership of a direct line from Oakland and San Francisco to Salinas, a distance of 128 miles, which is all to be electrified. The next move is the combination of the entire electric railroad systems and small steam railroads of this section and the extension of a line by this combination to Santa Barbara.

LONDON WATER CONSUMPTION.

The average daily supply of water delivered to London from the Thames River during August last was 138,599,861 gallons; from the Lea, 42,085,000 gallons; from springs and wells, 67,077,451 gallons; from ponds at Hampstead and Highgate, 3,000 gallons. The daily total was therefore, 247,765,312 gallons for a population estimated at 6,840,367, a daily consumption per head of 36.22 gallons.

INDUSTRIAL

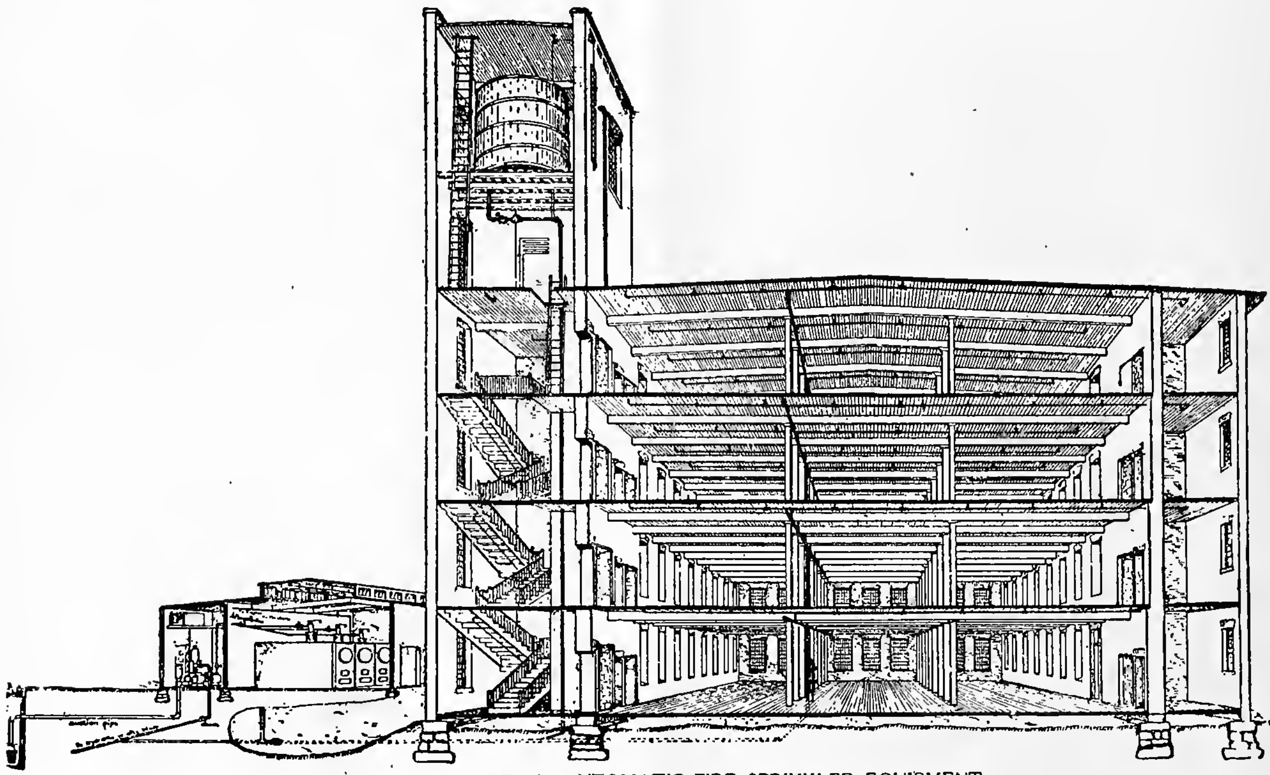
FIRE LOSSES ARE HEAVY.

Adequate fire protection has become a burning question with property owners. In the past sixty-five days upwards of $375,000 of lumber manufacturing property has been destroyed in the states of Washington and Oregon. In the same period proportionately heavy losses have been incurred in California, Idaho and British Columbia mills.

The quick destruction of property has naturally awakened apprehension and anxiety on the part of those having money invested in lumber and allied industries, and it is but a logical sequence that many are now devoting considerable time to a careful and comprehensive study of the general problem of fire protection; and, also, that many are installing automatic sprinkler system such as the Grinnell Automatic Fire Sprinkler service of the Pacific Fire Extinguisher Company, 145-153 Howard street, San Francisco.

The disastrous fires of recent date are, without exception, of unknown source and occurred after the buildings had been closed for the night, for the noon hour, or for Sunday. The destruction of the property in each case is attributed to the fact that the flames got too good a start. That appears to be the correct explanation of all recent fires in this section. The records show that fires originating in working hours are seldom heavy losses, for the reason that the blaze is extinguished in its incipiency. So that with risk it largely is a question of the period of time elapsing between the beginning of the fire and the first application of water. Give the flames a handicap of a few minutes and it is almost a ten to one shot that the plant will be smoldering ruins, and and the reason for it is this:

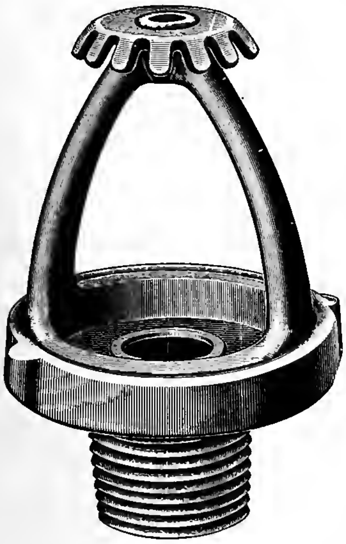
A plant containing 540 tons of combustible construction will burn in three hours, or at the rate of about three tons a minute. To extinguish any fire that requires that water shall be applied with sufficient rapidity to take up the heat as fast as it is generated by the fuel. If the heating effect is greater than the cooling effect, the water passes into steam or is decomposed. One pound of fuel will evaporate from twelve to eighteen pounds of water. The plant which is consumed in three hours, burning at the rate of three tons a minute, calls for at least fifteen tons of water per minute. Comparatively few risks can supply it through the medium of an ordinary portable hose service.



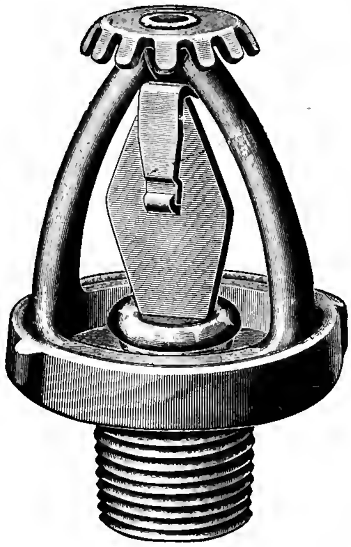
GENERAL PLAN OF AN AUTOMATIC FIRE SPRINKLER EQUIPMENT

This is where the strong feature of an automatic sprinkling service recommends itself. It prevents a fire from gaining headway and simultaneously turns in an alarm at any given point. Men who have studied the fire question for years say that a properly arranged sprinkler service will furnish the best possible fire prevention and reduce insurance rates from 33½ to 50 per cent. if installed under the rules and requirements of the insurance companies.

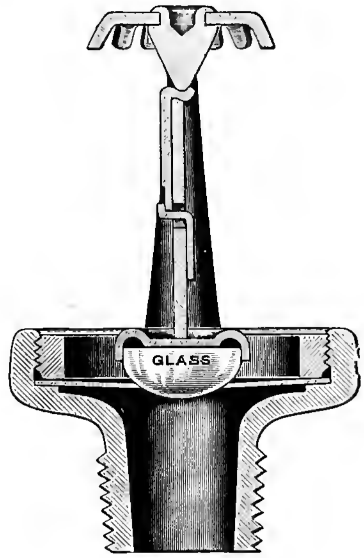
An automatic sprinkler system consists of piping run along and underneath the roof and ceilings of buildings, the different lines of pipe being from eight to ten feet apart, with self-opening sprinkling valves every eight feet. These valves are held closed by metal alloy, which melts at a temperature



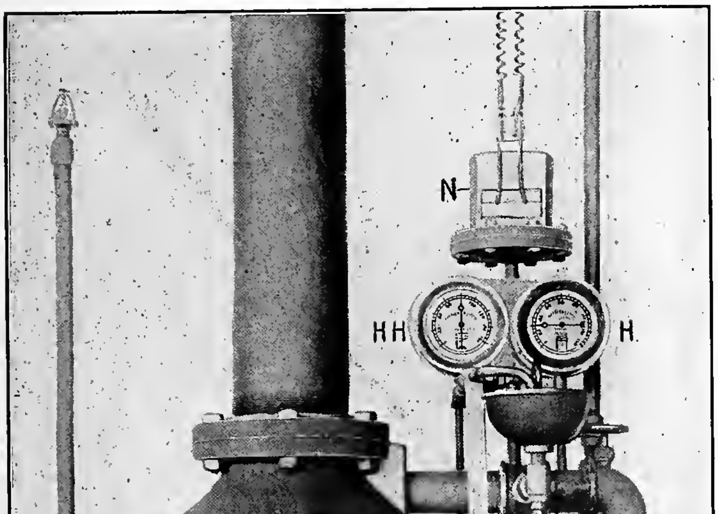
FULL SIZED SPRINKLER, OPEN



SPRINKLER CLOSED



SECTIONAL VIEW



GRINNELL DRY PIPE SYSTEM

of 155 degrees. Each valve when open will distribute water in a heavy shower over an area of 100 square feet. They do not open by fire, but by the spread of heat in advance of the fire. The piping of the system is connected with a double water supply, which may consist of an elevated tank and a steam fire pump, or a pressure tank and connection with a street water main. The vital points are adequate water supply and properly constructed equipment.

Over 100,000 buildings in the United States are equipped with automatic sprinklers and they have successfully extinguished over 10,000 fires, with an average loss of less than $250, as compared with an average loss of nearly $8,000 on similar risks unprotected.

GAS AND GASOLINE ENGINES.

The rapid advancement and future success of gas and gasoline engines is well evidenced and assured by the announcement of the DuBois Iron Works, DuBois, Pa., a $1,000,000 corporation, which has taken over the entire business of the Lazier Engine Co., including the patents and designs of the latter company. They have not only improved the engine in construction and design, but have made it possible to operate them on natural, illuminating, coke oven gas, gasoline, alcohol, distillate, crude oil and kerosene, in sizes ranging from 5 horsepower to 300 horsepower.

Mr. Peter Eyermann, one of the foremost gas engine authorities, designers, and engineers from Germany, where explosive engines of all types have been developed to a greater extent and achieved greater success in the larger horsepowers, is chief of the engineering department, and under his designs and supervision the new and improved "DuBois" will be produced.

The officers of the company are: Mr. John E. DuBois, president; Mr. W. C. Pentz, vice-president; Mr. E. A. Badger, secretary and treasurer; with Mr. I. N. Hamilton as general manager. The sales and advertising departments will be in the hands of Mr. C. E. Stuart.

The head office and entire management will be located at DuBois, Pa., and at Buffalo, which formerly was the Lazier Engine Mfg. Co. headquarters, a branch office will be retained, together with branches in the principal cities throughout the country.

IMPROVED TYPE JUNCTION BOX.

A new method of manufacturing junction boxes has recently been adopted by Frank B. Cook of Chicago. This box is made of sheet steel, heavily galvanized; making it very much lighter than the old painted cast-iron boxes. The difference in weight is so great that it will effect a material saving in freight. It also makes it much easier to handle on the pole and furnishes a most economical and simple means for installing and splicing main leads of cable and extending branches of smaller cable to other distributing points. It renders sleeve splicing or wiped joints unnecessary. It makes cable testing a very simple matter, as the box can be opened more easily than can a cable joint.

It is absolutely moisture-proof, and has a sliding galvanized sheet-metal cover which furnishes added protection. The junction box is equipped with self-soldering nozzles, and is made, as noted above, of galvanized sheet steel, a rubber gasket rendering the joint between the cover and the box, moisture-proof.

The box is galvanized after being formed up, so that the galvanizing will fill all the joints and make the box air-tight.

In order to make sure that the joint is moisture-proof, the junction box is subjected to an air pressure test before leaving the factory.

The bottom of the box is about two inches deep so that paraffine or a compound may be poured in to that depth, after the cable has been brought in and spliced. This is an additional protection to the cable against moisture.

Another feature of this box is that it can be furnished separate, or may be installed alone originally and the terminal can then be added at any future time.

All Cook junction boxes are equipped with self-soldering nozzles which are a great convenience and very economical as they save the services of an expert cable splicer or of a plumber to make wiped joints. All that is necessary is to scrape the lead cable sheath bright and clean before inserting it in the nozzle. To solder the cable, a blow torch is applied to the outside of the nozzle, first wrapping tape or paper around the bottom to prevent the solder from running out. The necessary amount of solder and flux is inside of each self-soldering nozzle.

ELECTRICAL EQUIPMENT FOR MINES.

The Boston & Montana Mining Company, of Butte, Mont., has contracted for five electric locomotives and a complete underground haulage system. The engines will cost about $2,000 each and are to be delivered in ninety days. They will be of the Baldwin pattern, with Westinghouse equipment. The installation of these engines and proper electrical appliances to operate them will do away with the present system of tramming. When the Boston & Montana began operations men were employed to do the tramming, but eventually horses were substituted and are now in use.

ELECTRIC HEATING DEVICES.

No one could witness the operating exhibit of electrically-heated tools made by the Vulcan Electric Heating Company, at the Chicago Electrical Show, without being convinced of the entire practicability of electric heating devices of all kinds.

The Vulcan Company displayed electrically-heated tools operating at temperatures considerably higher than attempted commercially by other companies. Red hot branding tools are now being sold by this company, and their soldering tools are well known as providing ample and continuous heat economically.

A red-hot branding tool was operated continuously during the exposition, in branding souvenirs, and was quite a center of interest and wonder.

A large soldering tool, used in running a heavy seam, was also a very prominent feature of the Vulcan exhibit. This tool eats up a heavy bar of solder in a moment. Its high efficiency and capability of doing heavy work is very convincing.

The soldering and branding tools and other specialties are applicable to a great variety of work by simply furnishing special tips. Adaptations were shown to waxing, electrotyping, glass leading, shoe burnishing, felt burning, etc.

It is believed that the convincing demonstrations made by the Vulcan Company will lend tremendous impetus to the electric heating industry, as it must be evident that the lower-temperature devices can be developed and operated with greater ease than these high-temperature tools.

The enterprise always shown here on the Coast may be depended upon to take advantage of this opportunity, and there is every reason to believe that the electric heating industry will rapidly advance into the first rank and take its place on a par with electric lighting.

Considering the fact that electricity insists on developing heat upon all occasions, oftentimes very much to the disadvantage of motors, dynamos and other appliances, and that many and expensive expedients are adopted for the prevention of heat where it is objectionable, it would seem that the utilization of this form of energy will be fully appreciated and taken advantage of.

There is no better opportunity for central stations to increase their day loads and, in general, to secure additional business, than in introducing this extremely useful and economical commodity to their customers.

ADDITIONAL ELECTRICAL EQUIPMENT FOR THE WEST JERSEY AND SEASHORE RAILROAD.

Because of the increased traffic on the Camden-Atlantic City electric trunk-line, it has become necessary to add to the present rolling stock some twenty-one cars. Both the new cars and the generating apparatus necessary to care for the extra load, are similar to the present equipment. Each of the cars will be driven by a GE-69 (200 horsepower) double motor equipment and will be fitted with the Sprague-General Electric Type M control.

At the Westville power house a fourth 2000 kilowatt, 6600 volt, 25 cycle, three-phase, Curtis steam turbo-generator will be installed. Additional boiler capacity with the necessary condenser and feed pumps, switchboards, etc., will also form a part of the new equipment, as well as a 75 kilowatt, 125 volt, horizontal Curtis steam turbo-generator for excitation purposes. Three extra 700 kilowatt, air-blast transformers will step up the generator voltage to 33,000 volts for transmission.

Six 1000 kilowatt rotary converters will be distributed in the sub-stations; one each at South Camden, Glassboro, Newfield, Mizpah, Atlantic City, an done at the Westville power house. The accompanying air-blast transformers for these machines have a capacity of 370 kilowatts each, three being installed with each of these rotaries. The Pennsylvania Railroad has ordered all the additional apparatus, as outlined, from the General Electric Company which also furnished and installed the initial equipment.

WASHINGTON POWER DEVELOPMENT.

Frank Fanning, an engineer in the employ of the Great Northern Railway, is making preliminary surveys for a mammoth dam at the foot of Big Lake, where the location is declared to be admirably situated for water power development. The stream point is not wide, and the banks are of solid rock, but otherwise offering no great obstacles to engineering. It is given out that the power will be used to operate trains in the Cascade Mountains. It is planned to carry the water from the lake to the power plant in mammoth open flumes or cylinders. The distance is two miles, and will, it is said, supply a head of 100 feet of water, capable of developing between 90,000 and 100,000 horsepower.

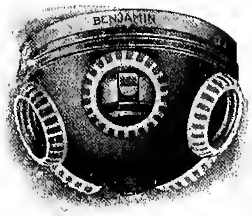
WIRELESS CLUSTERS—THEIR ADAPTATION TO BURNING TWO LIGHTS IN SERIES.

The Benjamin Electric Mfg. Co., Chicago, Ill., has placed upon the market a new line of devices in an adaptation of their wireless clusters to burning two lights in series.

Recent changes in the incandescent lamp situation, brought about by the use of metal filaments, have well-nigh established as standard, voltages of 120 and 125. In many cases where the wiring installation includes 220 volt circuits, there is therefore an increased demand for devices in which two lamps may be burned in series.

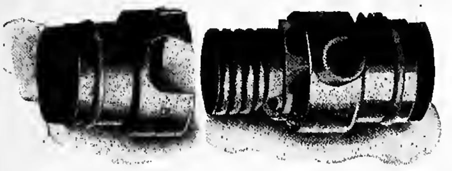
CUT 1

CUT 3



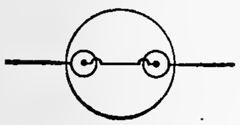
CUT 5

No. 22½ (cut 1) serves the general purpose of a two light device for ordinary cluster purposes. No. 92½, receptacle plug (cut 3), is furnished for 220 volt circuits wired in multiple, where it is desirable to use 110 volt lamps.

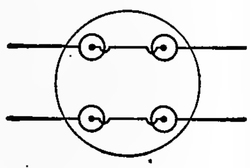


CUT 4

No. 412½, twin socket (cut 4), has heretofore been furnished for multiple work only. This can now likewise be used to burn two lamps in series. The device is largely used for show window lighting. Lamps may be placed parallel to the surface to which the socket is attached. The socket can also be used for fixture work with lamps placed either in a vertical position or in a horizontal position surmounted by half shades.

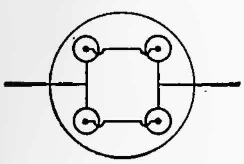


A

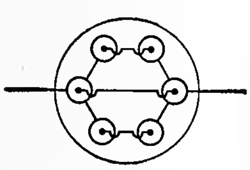


B

Diagram A applies to all of the aforementioned two light series devices.



C



D

For clusters ranging from 4 to 6 lamps, No. 15½ (cut 5) may be used as shown in the three diagrams, B, C, and D, permitting, first, the use of four lamps on two different circuits (cut B), two lamps in series on each; second, the use of four lamps on one circuit, two in series (cut C); or again, third, with six lamps in a series—parallel grouping, consisting of three sets of two lamps in series (cut D).

The San Francisco office of this company is No. 156 Minna street.

EARNINGS OF UNITED RAILROADS OF SAN FRANCISCO FOR YEAR AND STATEMENT FROM PRESIDENT THALMANN.

The gross receipts of the United Railroads of San Francisco for 1906 were $5,941,000, a loss of approximately $1,116,000, compared with the year 1905. The gross passenger receipts for December were $556,000.

President Thalmann, of the United Railways Investment Company, which controls the stock of the United Railroads of San Francisco, says: "The officers and directors of the United Railroads are confident that the rebuilding of San Francisco will go forward with continued vigor. The report that the labor situation is steadily improving, and that the company now has no difficulty in obtaining all the labor necessary for the reconstruction of its old cable lines, several of which have been completed, and the entire work of reconstruction will be finished by Spring.

"The delivery of the 250 new cars which were ordered by the company has begun, and when they are placed in the service the company should be as well equipped as any street railroad property in America. The new construction has been of the highest order. The officials of the company report a most favorable outlook for this year's business. It is confidently believed that the earnings for 1907 will exceed those of 1905."—From "Street Railway Journal."

NATIONAL ELECTRIC LIGHT ASSOCIATION COMMITTEE TO FORMULATE MODEL CONTRACT AND SPECIFICATIONS FOR STREET LIGHTING.

A new committee, appointed by President Williams of the National Electric Light Association, has been created for the purpose of formulating a model contract and specifications for street lighting. A great many inquiries have been made for such a contract—one that would be fair both to the lighting company and to the municipality, and one that would permit of changes in the form of illumination, as new developments were made in the art, on a basis satisfactory to both parties to the contract.

The personnel of the committee is exceptionally strong, the members being Dudley Farrand, Louis A. Ferguson, Paul Spencer, Charles P. Steinmetz and A. E. Kennelly, and very happy results are looked for in the report to be presented at the thirtieth convention of the association to be held in May or June next.

WATER POWER DEVELOPMENT IN THE SOUTH.

The water-power developments of the Southern Power Company in the Carolinas have become famous as being among the most extensive and most carefully executed enterprises of the kind in the country. The Southern Power Company's mains will, when their developments are complete, cover many hundreds of square miles of the "Piedmont Region" with a network of transmission lines for furnishing power for cotton mills and light for the towns and cities of the district.

The City of Statesville, N. C., has recently purchased three 500-kilowatt, Allis-Chalmers Power Transformers for use on the Southern Power Company's circuits, which supply the city at primary voltages of 40,000, 20,000 and 10,000 volts. The secondary voltages for use in Statesville will be 2,300 and 575 volts.

NEWS NOTES

POWER AND LIGHT PLANTS.

Baker City, Ore.—The council has awarded contract to the Baker Light & Power Co. to furnish electricity for lighting the city for one year. The city is contemplating the erection of a municipal electric light plant next year and to utilize the water power from its gravity water system.

Boise, Ida.—Guy C. Barnum, of Shoshone, has sold his interest in Thousand Springs Land & Transportation Co. to A. M. Harris. The company is building a power plant in Lincoln that will develop 12,000 horsepower.

Cheyenne, Wyo.—The Northern Colorado Power Co., which purchased the plant of the Cheyenne Light, Fuel & Power Co., is contemplating the erection of a new electric plant. Estimated cost, $1,000,000.

Kalispel, Mont.—The interest of the Tinkels and Conrads in the Big Fork Water Power plant has been taken over by the Flathead Valley Power Co. $50,000 will be expended in improvements at the Big Fork plant. 2,000 horsepower will be developed. C. T. Moffett, manager.

Livingston, Mont.—The Livingston electric light plant has been sold by J. L. Bright to Henry F. Kroyer, of New York. M. Hebgen, superintendent of the Butte Electrical works, will supervise the work of extending the power from the Madison River Power Co.'s lines to connect with the plant here.

Pineville, Ore.—Bids will probably be received in May or June for the construction of a plant for the Pringle Falls Electric Power & Water Co., to cost about $200,000. W. H. Huston, engineer; L. B. Lafolett, secretary.

Columbia, Wash.—The council is now considering a petition presented to it asking that a franchise to furnish the city with one hundred gas lights for $20 a year each be given to H. C. Miller.

Coeur d'Alene, Ida.—The W. W. P. Co. has a surveying party here surveying for a power transmission line from Spokane to the Coeur d'Alene district.

Edmonton, Alta.—It is proposed to install at the electric light plant a 1,000-kilowatt, three-phase, sixty-cycle, 2,400-volt turbo-generator set (steam) auxiliaries. R. R. Kelly, city engineer.

Grace, Ida.—The Telluride Power Co., Salt Lake City, will erect a new power plant in this city at a cost of $1,000,000.

Spokane, Wash.—The Spokane Merchants' Police and Detective Agency is soon to install the most up-to-date system of police patrol signal boxes in existence, states W. E. Stauffer, president of the Merchants' Police.

Bremerton, Wash.—Authority has been received to proceed with the erection of a central power plant at the yard, and allowing $178,000 with which to begin the work.

Coeur d'Alene, Ida.—Council granted a gas franchise to Frank Price and associates, of Spokane.

Corvallis, Ore.—Council adopted a resolution that bonds of the city be issued in the sum of $10,000 for the construction of a municipal light plant.

Chesaw, Wash.—J. Shaw contemplates installing an electric light plant at this place.

Juneau, Alaska—The Reynolds-Alaska Development Co. has installed a complete electric equipment on La Touche Iron Mountain Mine on Prince William Sound.

Prineville, Ore.—The Prineville Light & Water Co. is considering the proposition of putting in a power plant on the Deschutes River.

Rosalia, Wn.—Council has granted a franchise for an electric lighting and power plant to the Spokane & Inland Empire Ry. Co.

Starbuck, Wash.—The Starbuck Electric Light & Power Co., with $10,000 capital, by M. Pretizyoki, A. C. Warren and Z. Pietizyoki.

Washington, D. C.—Authority has been granted to the reclamation service by the secretary of the interior to purchase under competitive proposals the necessary equipment consisting of machinery and its utilization at the tunnel headings and other points on Tieton irrigation project.

Coeur d'Alene, Ida.—John Carr and associates have applied for a gas franchise.

Helena, Mont.—The gates were closed in the Hauser Lake dam. It will be three weeks before the power is turned on, as it will take this time for the lake to fill. The water will back up eighteen miles in the river and through the Prickly Pear Canyon, six miles in the valley below Helena. The dam is 640 feet long and seventy feet wide, and is made of steel throughout. Fifteen thousand horsepower will be generated. The power will run the Washoe Reduction Works, the Anaconda Railway, light that city, and operate many of the Butte mines.

Ketchikan, A.—The electric lighting plant recently destroyed by fire will be rebuilt at once. New machinery has been ordered.

Missoula, Mont.—Manager J. A. Jones, of the Missoula Gas Co., states a site has been purchased for the gas plant. The building will be constructed of concrete blocks, and will cost $7,500.

Missoula, Mont.—Mr. Wethey, of the Missoula Light & Water Co., states the company will enlarge the power house. Three 800-horsepower turbines will be installed.

Portland, Ore.—The Portland General Electric Co. has applied for a permit to construct conduits and lay wires underground.

Spokane, Wash.—G. W. Armstrong states that work on the new gas plant will be commenced early in the spring. Ten miles of mains will be laid this year.

Sarcoxie, Wyo.—The Sarcoxie Electric Light & Milling Co. has increased its capital stock from $7,500 to $16,500.

Petaluma.—The annual meeting of the stockholders of the Petaluma Water and Power Company was held January 7th. The old board of directors was re-elected, as follows: A. B. Hill, H. T. Fairbanks, H. E. Lawrence, Conrad Poehlmann and M. Doyle, and the board reorganized by re-electing A. B. Hill president; H. T. Fairbanks, vice-president, and Fred W. Heseker, secretary and superintendent. During the past year the company has expended a large amount in the improvement of the local water system, and will expend a far greater amount during the present year.

Fernie, B. C.—The Crow's Nest Pass Coal Co. will erect a large power plant here during the winter. Address General Manager Lindsay.

Portland, Ore.—The Portland General Electric Co. has been granted a franchise for a steam heating plant to cost about $300,000.

San Francisco.—The Farmers Light & Power Company, has filed articles of incorporation with the County Clerk. The corporation has an authorized capital stock of $2,000,000, and will deal in electricity for lighting and power. The directors are: H. D. Colyar, Olin L. Berry, F. E. Brady, G. W. Miller, C. W. Doble and John Royles.

ELECTRIC RAILWAYS.

Palouse, Wash.—The Spokane & Inland has a crew at work on the framework of the big viaduct which is to be built across Main Street and the Palouse River, from the depot to the warehouse district, a distance of 940 feet. Another crew is excavating for the new $18,000 depot which will be built in the Spring. The main building will be 60x60 feet, and at the rear will be the freight shed, 36x100 feet.

Seattle, Wash.—The Seattle Electric Co. was granted a franchise to lay tracks on Taylor Avenue, around Queen Anne Hill, on Third Avenue So., and on Prefontaine Place. The company plans to build 40 miles of new tracks during the present year.

Seattle, Wash.—Merle J. Weightman states that the new Seattle-Tacoma interurban line is financed, and construction will begin by May 1st.

Spokane, Wash.—The Spokane & Big Bend Ry. Co. has closed a deal with Jay P. Graves and associates to run its cars in and out of Spokane over the new Graves line, which is soon to be built down the river. The Big Bend Co. is also to procure its power from the power plant being constructed by the Graves Co., near Nine-mile Bridge.

Tacoma, Wash.—Contractors for the Pacific Traction Company have a crew of men at work on the company's underground crossing at the junction of its American Lake line and the Northern Pacific tracks.

Tacoma, Wash.—Work has been commenced on the installation of the "S" tracks being laid by the Tacoma Ry. & Power Co., at C Street and Jefferson Avenue.

Tacoma, Wash.—C. E. Muckler, of Tacoma, and Merle J. Wightman filed acceptance with the county commissioners of the franchise granted them for their line of interurban electric road from this city to the King County line en route to Seattle.

Spokane and Big Bend Railway—Col. W. H. Plummer, president, announces that traffic arrangement has been made with Jay P. Graves, president of the Spokane and Inland Empire system, to run its cars in and out of Spokane over the latter's line, to be built to Seven Mile Bridge, also that a line will be constructed to Davenport, 37 miles. Grading is to be begun at once. A syndicate at St. Louis, Mo., it is announced, will finance the project taking $2,500,000 in five-per-cent., ten-year bonds, certified by the Spokane & Eastern Trust Company. The line will tap the Big Bend country, the richest wheat belt in Eastern Washington.

Spokane and British Columbia—H. W. Warrington, chief engineer and general superintendent, in Spokane, said that construction work is in progress on the line from Grand Forks, B. C., north to the mining camps at Franklin. The road is operating from Republic, Wash., to Grand Forks, 40 miles, and with the completion of the Franklin branch, up the north fork of the Kettle River, will have 90 miles of road in operation. The extension from Republic to Spokane will follow.

Washington Water Power Company—Harry M. Richards, president, announces that plans are making for increasing the company's electric plants to 10,000 horsepower using the waters of the upper and lower falls in Spokane; 50,000 horsepower, Post Falls, in the Spokane River in Idaho; 15,000 horsepower and a stream auxiliary plant of 6,000 horsepower. The company proposes increasing its capital from $5,000,000 to $10,000,000 at a meeting of stockholders called for March 4.

Columbia and Walla Walla and Traction.—J. H. Morrow, general manager, and promoter of the Farmers' line between Dayton and Wallula, by way of Walla Walla, Milton and Freewater, says farmers along the line are donating land for right-of-way, and the contracts will be let in a short time.

United Copper Company—Announcement is made that the survey of the line from the mines at Chewelan to the Spokane Falls & Northern yard, six miles, has been completed, and that the grade will be better than was expected. Work will begin next Spring.

Monterey, Cal.—The survey of the Monterey and Fresno Railway is progressing. There are four gangs in the field. The party working from this end is nearly to the Salinas River. Another party is working out of Fresno toward the Los Aiglas Pass. At Los Aiglas Pass there is a party of surveyors on each side of the mountains. At Hollister the officials of the Monterey and Fresno Railroad applied for a franchise through that city. Next week a franchise will be asked at Fresno.

Spokane & Inland Empire System—J. B. Ingersoll, general manager, has placed an order for 250 box cars with the Seattle Car Company, for delivery prior to July 31. The cars are of the 40-foot type with 80,000 pounds capacity. He will also place orders in a short time for 12 Brill passenger coaches and 50 flat cars. With these the company will have 450 freight cars in commission.

Boise, Ida.—The county commissioners have granted a franchise to W. D. Kenyon, Paul R. Kartzke and J. C. Rogers to build an electric railway from the Snake River at this place, to the town of Oakley, a distance of 25 miles.

Cheney, Wash.—Engineer Andrews, of the Cheney electric line, reports that work is progressing rapidly on the uine between this place and Hayford. Five construction camps are established.

Caldwell, Ida.—C. J. Franklin, of Boise, supervising engineer of the new Boise and Caldwell interurban railway, is here inspecting the new steel bridge across the Boise River at this place.

Washington Water Power Company—D. L. Huntington, general manager, announces that a party is surveying for a power transmission line from Spokane to the Coeur d'Alene Mining District, 40 miles, this doubling the present service of 4,000 horsepower.

Helena, Mont.—It is reported that plans are on foot for the construction of an electric railway from this place to Butte, a distance of 53 miles.

Portland, Ore.—C. E. Loss announced that the United Railways has placed orders for $130,000 worth of steel rails. The extension to the city lines alone will cost $850,000, and it is the intention to build an interurban track to Hillsboro and Forest Grove.

San Francisco, Cal.—Reports are in circulation regarding the organization of a new company, which proposes to put up a hot fight for the street railway traffic of this city. The report is that a company of Los Angeles capitalists is to be supported in the project of building an electric street car system across town, through the busy manufacturing districts, in competition with the United Railroads. For some time a committee of the Potrero Commercial and Manufacturing Association has been engaged in an attempt to secure better street car service through the manufacturing districts on the water front, as there are between 50,000 and 60,000 workers who must be taken care of. At present the facilities are meager, and another effort will be made to secure recognition for the Potrero.

Watsonville, Cal.—J. B. Rogers, chief engineer of the Ocean Shore Railroad, says that the Ocean Shore will be completed as a single-track line from San Francisco to Santa Cruz by October 1st. Nearly 67.5 per cent of the grading and 85 per cent. of the necessary fills and bridge approaches have been completed. He says: "The road is in good hands. Eighty per cent. of the stock is owned in San Francisco by men who are heartily interested, not alone in the construction of this line, but in seeing that it is maintained in local hands."

San Francisco, Cal.—Judge Edward Whitson, sitting in the U. S. Circuit Court, yesterday issued a temporary restraining order in the case of the San Jose Railroad Co. against the San Jose and Los Gatos Railroad Co., enjoining the defendants from constructing a street railroad along San Fernando Street, between Second and Market Streets, San Jose, and running cars there. The defendants have been ordered to show cause, on Monday, February 4th, why the injunction should not be made permanent.

TRANSMISSION.

Redding, Cal.—J. A. Whitehead has deeded to the Pacific Power Co., for $10, sections 16 and 17, township 30 north, range 1 east; sections 19 to 30, township 30 north, range 1 west; sections 25, 26, 27, 32 and 33, township 30 north, range 2 west; a right to 40,000 inches of Battle Creek water, measured under a 4-inch pressure; a right to 20,000 inches taken from Baldwin Creek; a right to 15,000 inches taken from North Battle Creek; a right to 10,000 inches taken from South Battle Creek; a right to 6,000 inches from Carrah Creek, and 15,000 inches from the north fork of Battle Creek.

San Francisco, Cal.—The Risdon Iron Works has secured a contract with the Union Construction Co. for the entire hydraulic equipment of the plant of the Stanislaus Electric Power Co., with the exception of the water wheels and connections. The contract with the Union Construction Co. calls for two riveted steel pressure pipe lines, each approximately 3,800 feet in length, each line being 48 and 38 inches inside diameter. The Risdon people have the contract for the riveted steel header and connections, connecting the two pressure pipe lines to the water-wheel units. Also the contract for the mine pipe line on the opposite side of the river, leading from the power house to the top of the hill, for supplying mines with water from the power plant. The total length of the mine pipe is, approximately, 5,300 feet. The pipe lines will operate under a total head of 1,500 feet, or about 651 pounds per square inch. The diameters of the mine pipe line are 31 and 37 inches. The thicknesses of the riveted steel pipes in the pressure pipe lines and the mine pipe line and header vary from ¼ to 1 inch. The total tonnage of the hydraulic equipment under contract with the Union Construction Co. will approximate 2,500 tons.

Winnemucca, Nev.—The Western Pacific Railway Co. will install an electrical plant at Flower Lake Tunnel and use the power to run drills and light the tunnel.

INCORPORATIONS.

San Francisco, Cal.—The Nevada Oil and Development Co. has been incorporated with a capital stock of $50,000, by Milton Sprague, C. A. Roller, J. A. Campbell, E. E. Kindelspierre and Chas. Downing.

San Francisco, Cal.—The Pryal-Shean Electric Co. has been incorporated with a capital stock of $25,000, by C. L. Pryal, W. F. Shean and H. L. Horn.

Sacramento, Cal.—The Sacramento and Vallejo Railroad Co., backed by Sausalito and San Francisco men, has been incorporated to connect Sacramento and Vallejo by the most direct practicable route. It has not been decided whether or not the road will be operated by steam or electricity, but it will enter the corporate limits of each city and will be about 60 miles in length. Attorney Frank P. Deering, counsel for the new corporation, states that the construction of the road in the immediate future is assured and that men are already in the field securing a right of way and surveying the proposed route. The company is capitalized at $1,000,000, of which $60,000 has been subscribed and $6,000 paid up in cash. The directors are: Lucian W. Knight, of Sausalito; Benjamin Pringle, of Sausalito; and William G. Barr, of San Francisco.

Los Angeles, Cal.—The Farmland Water Co. has been incorporated with a capital stock of $75,000, by M. G. Fogg, A. L. Dewey and Myron Westover.

San Diego, Cal.—The San Diego Rapid Transit Co. has been incorporated with a capital stock of $50,000, by R. A. Smith, T. L. Lewis, R. B. Thomas, G. Y. Gray and E. W. Peterson.

Los Angeles, Cal.—The Creedmoor Land and Water Co. has been incorporated with a capital stock of $30,000, by F. W. Pitcher, N. E. Rice, J. M. Larraide, E. G. Wood and C. I. Parker.

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OIL.

Martinez, Cal.—Oil has been struck at the Bull's Head Oil Works, but the extent of the flow cannot yet be determined. For some time a well-boring machine has been at work at the Bull's Head under the direction of J. R. Van Gant. While nothing definite could be learned as to the purposes of the company, it was generally presumed that its object was to learn if any indications of oil existed in that locality. The well is down over 800 feet, and at present is being cleaned out to make a clear passageway for the oil.

Bakersfield, Cal.—That the standard pipe line to the West Side is to be realized is now established almost beyond a doubt. A surveying party, headed by a right-of-way agent, County Surveyor Buffington, Cliff Greely, George Borgwardt and several others, traveling in two teams, have begun setting stakes from the point where the tide-water pipe line joins the Southern Pacific tracks, one and one-half miles north of Oil Junction. The line taken by the surveyors is southwest, toward the West Side.

Coalinga, Cal.—The heavy rains of last week caused a lot of trouble with the Associated pipe line to Monterey. The line is broken in three places between Coalinga and Alcalde, and at various places above that point. It will take several days to repair the damage, and in the meantime no Associated oil is being moved.

Fresno.—Since the California Oil Fields Co., Ltd., recently acquired control of the eastern side of the oil district the situation has become more acute. This condition was brought about by the Associated, which contracted with the California Oil Field Co. to purchase 1,500,000 barrels of oil at an advance of 30 cents. The exact price in the opinion of the independents is 35 cents, though this figure has never been authoritatively confirmed, owing to the secrecy which governed the transaction. This contract calls for the delivery of not less than 4,000 barrels daily. All the independent producers, not under contract, formed an organization six weeks ago for the purpose of obtaining a higher price for their oil. At the time the independents formed, the price of oil was 19 cents on contract and 17½ cents on daily runs. Since then the purchasing companies have offered to take the oil on daily runs at 25 cents, and the Associated has offered to purchase the fuel oil product for 1907, on contract, at 27½ cents. The independents refused the offers and have every reason to believe that they will be paid their price—30 cents—because they control half of the product in the West Side field. The California Oil Fields Co., Ltd., is delivering 4,000 barrels daily to the Associated, but its output is 15,000 barrels a day.

WATER WORKS.

Redding, Cal.—The water that will be furnished to consumers in Redding through the new system to be installed by the Redding Water Co. will be pumped direct from the wells, and not from the river as is the present method. These wells will be dug on the property just purchased by the Redding Water Co.

Sacramento, Cal.—At the meeting of the Board of Trustees the specifications for the water mains on I street, to cost $27,000, were adopted.

Yuba City, Cal.—C. B. Andros, the new owner of the Yuba City water works, is having surveys made through the Cooper tract for the purpose of extending water mains to that part of the city. The capacity of the tanks will be enlarged and other improvements made to meet the increased patronage in the various additions of the town.

Los Angeles, Cal.—Sealed proposals are being received at the office of the treasurer, Pacific Branch, N. H. D. V. S., Soldiers' Home, Los Angeles county, for furnishing and installing a water pumping plant, in accordance with plans and specifications.

ILLUMINATION.

San Francisco, Cal.—Fire destroyed the Rio Vista Light & Power Plant at Rio Vista a few days ago, causing a loss of $10,000.

Los Angeles, Cal.—An ordinance has been adopted by the city providing for lighting Broadway from Temple to Main, for one year.

Los Angeles, Cal.—Authentic reports are to the effect that a corterie of capitalists is negotiating for a controlling interest in the Lowe or People's Gas Light & Coke Co., and that Prof. Lowe, the owner, is taking kindly to the plan. Reports concerning the formation of another company are rather vague, but in certain quarters it is declared that a third company is being formed. Dr. John R. Haynes is mentioned as one of the capitalists, but denies knowledge of the scheme. Reports have it that the new interests plan for a large capitalization so that mains can be extended and plants of the Lowe type of gas manufacture be erected for 500,000 consumers. Plans of the Los Angeles Gas & Electric Co. provide for expenditure of a large amount of money for increasing capacity of their present plant.

Anaheim, Cal.—Geo. M. Ross, of the local gas company, has made application for the establishing of a gas plant at Fullerton, which the city trustees have agreed to advertise. Mr. Ross is backed by local capital, and if he secures the franchise, he will install the plant at Fullerton without delay.

Kelseyville, Cal.—An ordinance has been passed by the Board of Supervisors granting the Lake County Electric Power Co. a franchise for erecting and maintaining a wire line for the transmission of electric power along certain streets and public highways in the County of Lake, for the purpose of supplying heat, power and light.

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The Engineers', Architects' and Builders' News

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The Engineers' Architects' and Builders' News

VOLUME XVIII. SAN FRANCISCO, CAL., FEBRUARY 16, 1907 No. 7

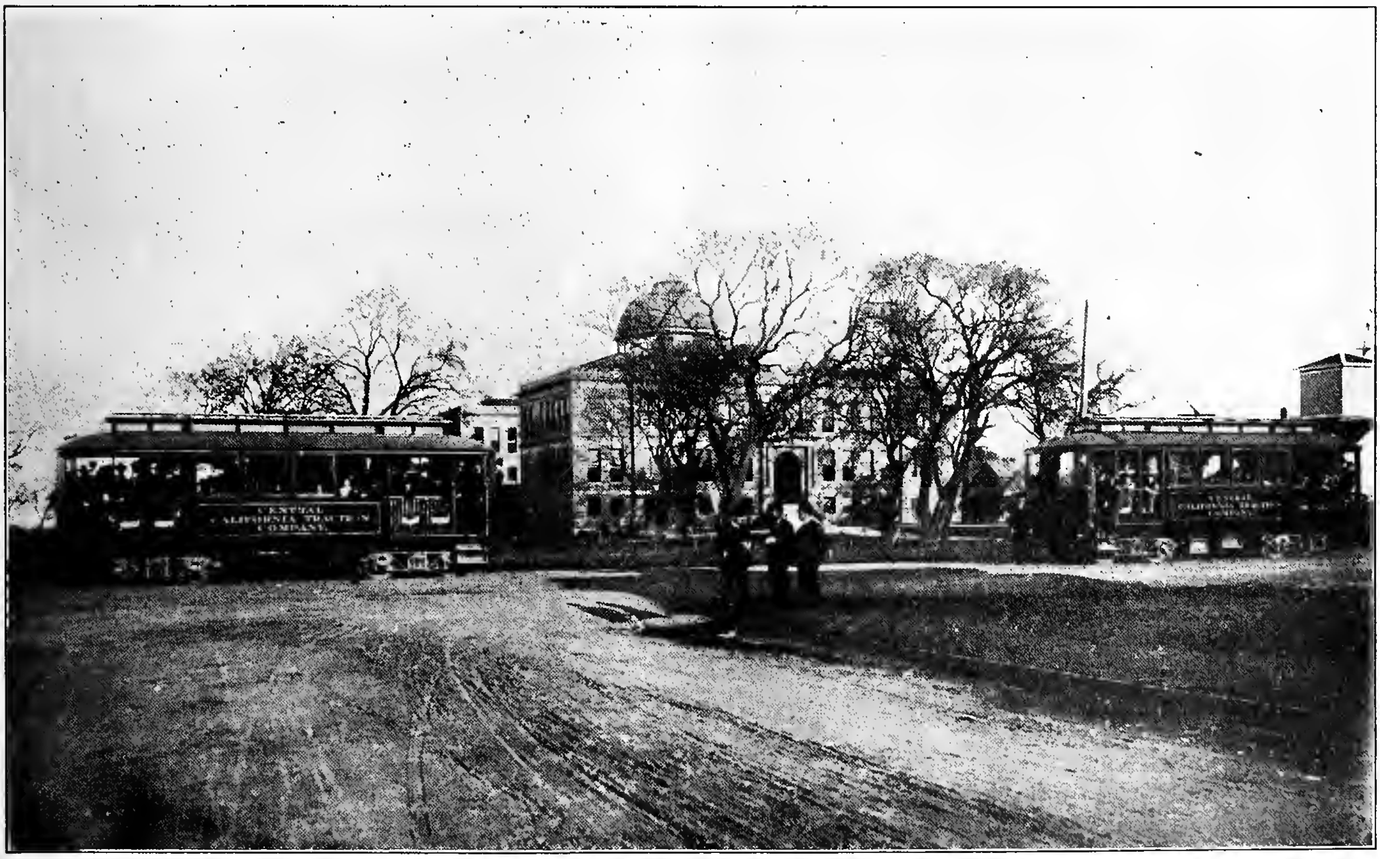
The Street Railway Systems of Stockton, California

As the shipping center for the products of one of California's largest and most fertile valleys, the city of Stockton, with a population of 25,000, ranks among the important commercial cities of the state. Stockton has at present two independent electric street car systems, both of which are equipped with new cars and maintain a five-minute schedule on the principal streets, giving it a much better service than is usually found in cities of its size. The lines extend beyond the city limits for a few miles to give passenger service to the recreation parks and other places situated in the suburbs.

The regular five-cent fare is charged, but for the accommodation of school children, tickets are sold, arranged in book form, at the rate of two and one-half cents for each trip. These may be used between the hours of 7 a. m. and 5 p. m. except on Saturdays and Sundays. Tickets are also issued for the night school children and are good up to 10 o'clock.

Both companies have adopted the system of stopping at the near street corner, but this is not always rigidly adhered to on account of some local street crossing conditions.

The narrow-gauge line of the Stockton Electric Railroad Company began operation about fifteen years ago. In the summer of 1906, this company converted its entire line to the standard broad gauge. The old tracks were torn up with the aid of a traction engine, and small pile-drivers were used to break up the hard bitumen. Within the city limits the new tracks are built of 114-pound girder rails, 62 feet long. In the suburbs a 60-pound T rail is used. The rails are laid on redwood ties and imbedded in four inches of concrete, making an excellent road bed. The rails are bonded with a four-naught concealed bond. The trolley wire is of the overhead span construction.



CARS OF THE CENTRAL CALIFORNIA TRACTION CO., SHOWING STOCKTON'S NEW HIGH SCHOOL IN THE BACKGROUND

The conversion of the road into broad-gauge necessitated the purchase of new cars for the entire system. These were built by the St. Louis Car Company, are 35 feet long and of

the double trolley-pole type. Each car seats forty passengers. The seats are arranged transversely and the inside seats are rattan upholstered. Each car is equipped with two General Electric type 80 motors, and the Christensen air brake equipment.

A well constructed red brick car barn, 160 by 114 feet, was recently built about two-thirds of a mile outside of the city limits. Eight tracks run into the building and thirty-two cars can be easily housed. Pit room for eighteen cars is provided, which is unusual in car barns of this size. Space in the rear part of the building has been allowed for the installation of machine tools, which are to be driven by a 7½ horsepower 500-volt direct current motor running at 1650 revolutions per minute. Separate locker rooms with individual lockers are provided for the car crews and the shop employes. The blacksmith shop and oil shed are situated behind the car barn in the company's construction yard.

Electrical energy for the operation of this road is obtained from the power house of the Stockton Gas and Electric Co. This power is at present supplied by two units, each of which consists of a General Electric two-phase alternating current machine of 200 kilowatts capacity direct connected to a Westinghouse direct current six-pole generator of 150 kilowatt capacity, which supplies power to the line at 550 volts. The alternating current generators are 12-pole machines of the revolving field type and operate at about 600 revolutions per minute. On the shaft between generators is mounted a driving pulley, and on the alternator end of the shaft is a small pulley for driving a General Electric 120-volt bipolar exciter, running at 1800 revolutions per minute.

Under normal conditions the power is taken indirectly from the standard line of the California Gas and Electric Corporation. From 60,000 volts, three-phase, the pressure is stepped down to about 2300 volts, two-phase, by means of Scott connected transformers. Current at this voltage drives the alternating-current generators as synchronous motors, which supply the mechanical power for operating the direct-current generators. Should the transmission line fail, the four machines of both units are operated as generators by belt connection with three tandem compound Ball engines of 250 horsepower each. The direct current generators supply power for the railway load as before, while the alternators now supply the city power and lighting circuits controlled by the Stockton Gas and Electric Company.

A Westinghouse motor-generator set has just been installed to provide additional power for the Stockton Electric Railroad Co. This consists of a 580 horsepower, three-phase induction motor to operate at 500 revolutions per minute at a pressure of 2200 volts, and a direct current, six-pole, 600-volt generator mounted on the same shaft, of 400 kilowatt capacity.

About a year ago the Central California Traction Co. completed the construction of its independent lines; and since then the cars of this company have been sharing the street car traffic of Stockton with those of the older company. Part of the cars were made by the St. Louis Car Co. and the rest by the J. P. Hammond Co. of San Francisco. These cars are of the single trolley pole type, are 32 feet long and seat forty passengers. The seats on the inside run lengthwise and are carpet covered. The motor equipment of each car consists of two Westinghouse type 92A 35 horsepower motors. National airbrake equipments are used on all cars.

A feature of these cars is that the headlight is arranged on the roof of the car instead of below the motorman's window, as is usually the case. There are several advantages derived from this arrangement. The headlights, on account of their increased elevation, add greatly to the ordinary street lighting and insure greater safety to passersby. The streets of Stockton are heavily shaded with trees and the motormen can more readily see prospective passengers waiting on the sidewalk corners.

When the cars first began to operate, the glare from these arc headlights considerably annoyed passing teams and auto-

THE COUNTY COURT HOUSE, STOCKTON, CAL.

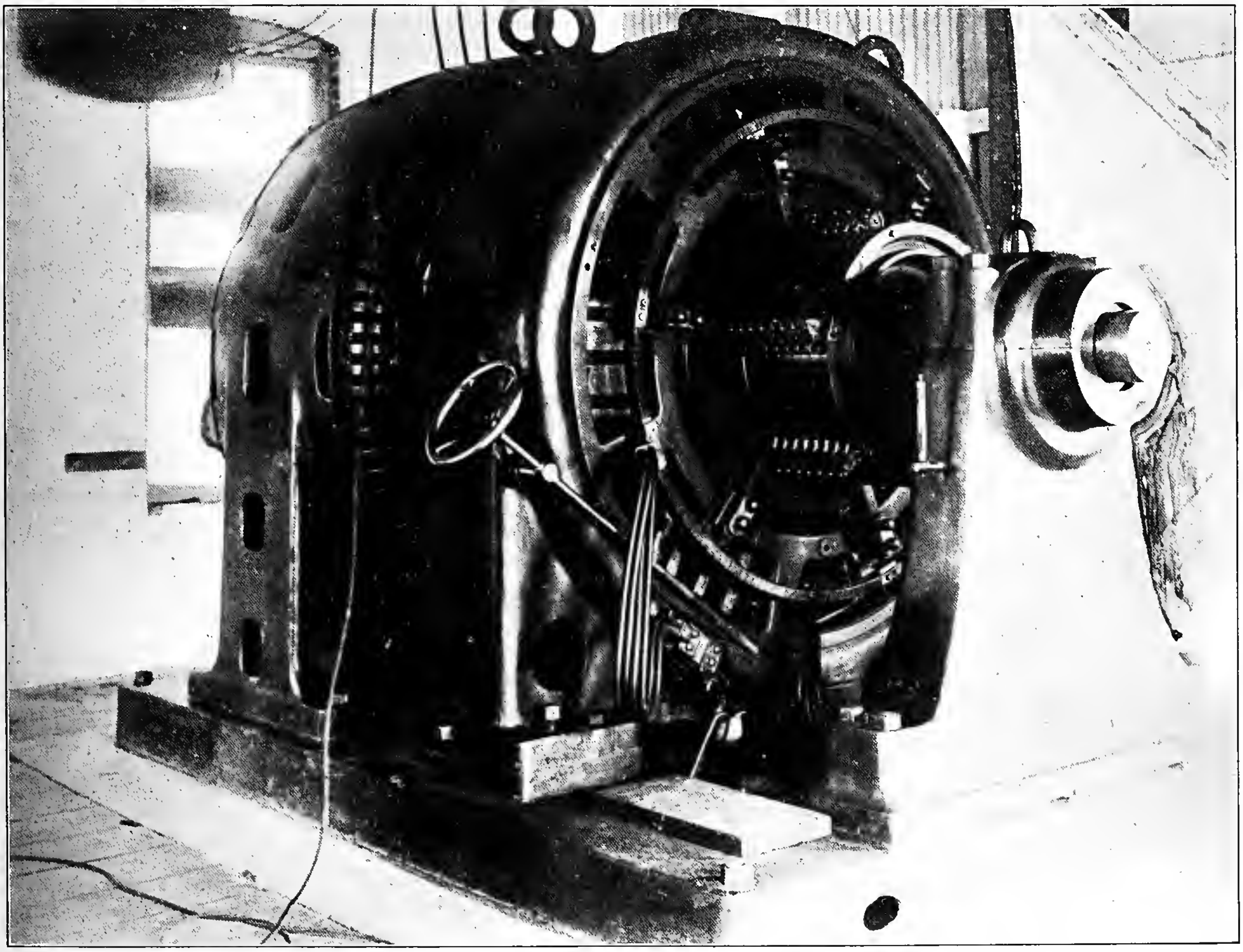
mobilists, as no dimmers are used. The people have, however, now become accustomed to them, and many automobilists greatly enjoy driving at night behind one of these cars on the opposite track as they can see ahead distinctly and are entirely screened from the glare of the headlight.

Instead of the usual wiring with resistance coils, considerable economy is effected by using the incandescent lamps as resistance, with the result that the cars are brilliantly lighted by energy that is ordinarily wasted.

The fenders are made of steel rods and are similar in construction to those commonly used in California. The tripping devices are, however, given special care to keep them in good working condition. Although no accident involving a human life has yet occurred with these fenders, about forty or fifty dogs have been picked up within the past year, and of these only two were injured, probably by being caught by the side of the truck.

inghouse oil-cooled transformers, Y connected on the primary side with neutral grounded, and delta connected on the secondary side. The taps are taken out at the middle. Power at this lower voltage is supplied to a Westinghouse motor generator set situated in an adjoining room. This consists of a 585 horsepower, three-phase, induction motor mounted on the same bed plate with a 400 kilowatt six-pole direct current generator, which supplies all the power needed for the operation of the cars. Ordinarily a station voltage of about 575 is maintained. The machines run at about 500 revolutions per minute.

The tracks are standard broad gauge and are built of 75-pound steel rails laid on redwood ties. From 6 to 8 inches of gravel ballast was used with concrete tamped under the rails in the usual manner. On streets paved with bitumen the space between tracks is filled in with concrete and covered with a 3-inch layer of bitumen; on other streets gravel is used. The rails are



400 KILOWATT MOTOR-GENERATOR SET IN THE SUB-STATION OF THE AMERICAN RIVER ELECTRIC CO., STOCKTON, CAL.

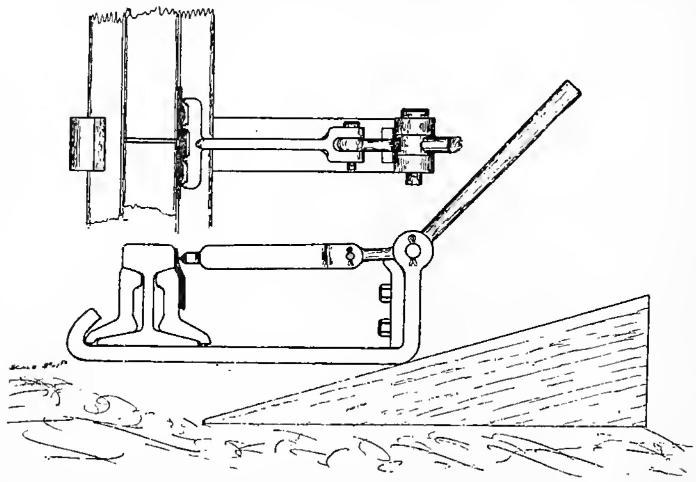
The present car barn is a corrugated iron building 168 feet long and 56 feet wide. It is traversed by four tracks with a liberal amount of pit room. The machine shop equipment includes a belt-driven lathe with a 24-inch swing and 12-foot bed, an 18-inch shaper, a 24-inch drill press, and a bolt cutter with a maximum capacity of 1½ inches. These together with the auxiliaries are driven by a Wagner 5-horsepower single-phase motor operating at 208 volts. In the rear of the building is a large yard for the storing of construction material.

Power for this line is transmitted a distance of 80 miles from the hydro-electric power station of the American River Electric Co. at Placerville. It is received at the local sub-station of the same company at 33,000 volts, three-phase; and, for the traction load, is stepped down to 2200 volts by three 150 kilowatt West-

bonded with a 0000 B. and S. gauge copper and soldered bond. The accompanying sketch shows a toggel clamp designed by Mr. H. W. Crozier, the electrical engineer of the company, for holding the bond in place while it is being soldered.

The Stockton lines of the Central California Traction Co. is but a part of an interurban system being built to Lodi, a distance of 15.2 miles, with a later extension to Sacramento—an additional distance of about 35 miles. The construction of this road includes several novel features, one of which is the prospective use of direct current at 1200 volts, not heretofore successfully realized.

The cars on the interurban lines proper will be operated from a third rail, while the overhead caternary construction is to be used on the city lines. This latter type is used at present in con-

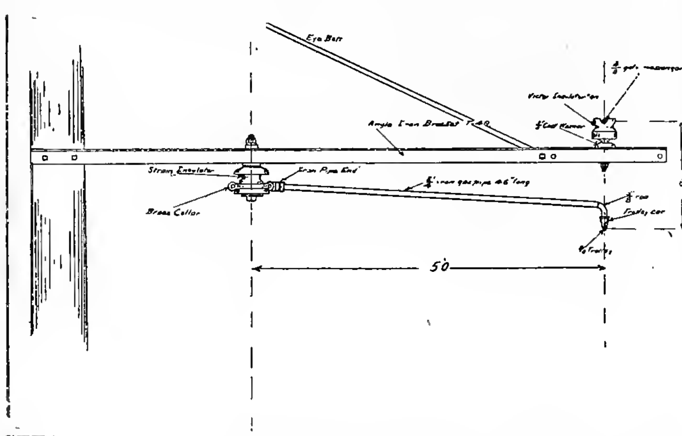


TOGGLE JOINT USED BY THE CENTRAL CALIFORNIA TRACTION CO. FOR HOLDING THE BOND DURING SOLDERING.

nection with the span wire construction on the lines now in operation in Stockton. The wires are supported by wooden poles set ordinarily about 120 feet apart, with the wires 20 feet above the top of the running rail. The steady brace shown in the accompanying sketch is used on every seventh pole along straight tracks and on every pole around curves to hold the wire in position. The trolley wire is a 000 B. and S. gauge copper conductor, and is suspended from a ⅜-inch galvanized iron messenger cable by adjustible spacers. The existing span wire construction will be retained on the straight runs if it is found to work satisfactorily with the new interurban cars. The trolley wiring on all curves is to be changed to the caternary type.

For the third rail construction a 40-pound A. S. C. E. standard rail of a conducting equivalent equal to 400,000 circular nils is to be used. This will be mounted on brackets set 12 feet apart. The bracket insulators will be of reconstructed granite, and the third rail will be covered on the top and sides by a board covering to keep foreign objects from coming in contact with the live rail. The difference in elevation between the top of the running rail and the bottom of the third rail is three inches.

The cars for the interurban traffic will be 50 feet long and equipped with four General Electric 75-horsepower 1200-volt motors to be operated by the Sprague General Electric system of multiple unit control. These motors will be geared for a speed of fifty miles per hour. Within the city limits the cars must necessarily be run at a lower speed, and the change from



STEADY BRACE FOR BRACKET CENTER POLE, CATENARY CONSTRUCTION.

a voltage of 1200 to that of 550 on entering the city will introduce no difficulties as far as the speed of the motors is concerned.

The lights, heaters and air pump will be operated on 550-volt circuits to be supplied by a dynamotor on each car during third rail contact. When, on entering the city, the change is made to a trolley potential of 550 volts, the dynamotor will be cut out and the auxiliaries will be operated directly from the trolley wire.

The work of constructing the interurban line is well under way; about two miles of track has already been laid.

To supply the additional electric power required for the operation of the interurban line, a new sub-station is to be built in which will be installed two motor generator sets of 500 kilowatt capacity each. Suitable transformers will be provided for stepping down the voltage from the high tension transmission line to that required for operating the induction motors.

The Central California Traction Co. has admirable facilities for receiving and handling construction materials for the new road. Spur tracks have been built from the city lines so that the company can load its cars directly from the cars of the Southern Pacific, the Santa Fe or the Western Pacific Railway systems. For general hauling and transporting materials of construction the company built a flat motor car at its own shop, which, on account of its many merits, is the pride of every shop employe of the company. This car weighs 21 tons and carries five tons of steel rails as ballast. It is equipped with four Westinghouse, 35-horsepower motors and a Westinghouse combined straight and automatic air brake equipment. The automatic air brake is similar to those generally found in the cabs of steam locomotives. The circuit breaker can be operated by pulling a suspended cord, which is a great advantage in coupling cars.

The officials of the Central California Traction Company are: E. P. Hilborn, general manager; R. S. Masson, consulting engineer; H. W. Crozier, electrical engineer; and D. S. Unruh, roadway engineer.

PACIFIC COAST TELEPHONES.

Pacific coast states claim the greatest telephone density of any section of the country—if not the world. In California, Washington and Oregon, the telephone development has been marvelous and the prospects are that 1907 will eclipse all records in the extension of existing lines and the construction of new systems. The following table shows the number of telephone stations according to population in the larger cities of the coast states:

	Population.	Stations Per 100
Los Angeles	220,000	13.15
San Francisco	325,000	5.04
Portland	175,000	10.90
Seattle	182,000	10.10
Oakland	106,000	11.02
Spokane	56,320	19.23
Tacoma	75,000	10.86
Pasadena	23,000	18.20
San Jose	32,000	16.53
Sacramento	40,000	11.32
Fresno	23,000	16.58
Berkeley	32,000	10.92
Alameda	18,000	12.65
Bellingham	25,000	9.54
Walla Walla	21,000	9.80

GOOD ENGINEERING.

In the "One Horse Shay," Dr. Oliver Wendell Holmes, as well as the good deacon, builded better than he knew; for it should not be considered merely as a logical triumph, but as an ideal of the accuracy of engineering calculations in correctly estimating the strength of each part, and exactly providing for the depreciation of the whole work.—Mr. C. J. H. Woodbury.

THEORY OF ELECTROLYTIC CORROSION.*

By Prof. Ganz.

Electric conductors are divided into two classes, namely.

1. Metallic conductors, which transmit electric currents without chemical decomposition; and,

2. Electrolytic conductors, or electrolytes, which transmit electric currents by a corresponding transfer of ions in a solution, thus producing chemical decomposition at the electrodes.

The metals are the most common metallic conductors. Chemical compounds in solution, which can be decomposed by an electric current, are electrolytic conductors, or electrolytes.

Pure water has such a high resistance that it may practically be considered a non-conductor. Water is made conducting by the addition of salts or acids in solution, and conduction through water is, therefore, always electrolytic. For the present purposes we need only consider the electrolytes consisting of salts dissolved in water. The conducting terminals by which the current is led into and out of an electrolyte are called electrodes. The electrode by which the current enters is the anode, and the one by which the current leaves is the cathode. The following brief explanation of electrolytis conduction is in accordance with the modern theory of electrolytic dissociation:

When a salt is dissolved in water, some of the molecules separate or dissociate into two parts, one part having a positive electrical charge, and the other a negative electrical charge, and these parts are called ions. The metal part, or the hydrogen, is the positive ion, and the acid part is the negative ion. For instance, copper sulphate, CuSo4, when dissolved in water, dissociates into the positive metal ion Cu, and the negative acid ion, So4.

An electric current is transmitted through an electrolyte by the motion of these ions. The metal or hydrogen (positive) ions travel in the direction of the current and carry positive electrical charges to the cathode, and those metal ions, called cations, are deposited upon or are liberated at the cathode. The acid (negative) ions travel against the current and carry negative charges to the anode, and these acid ions, called anions, will corrode the anode if it is a metal which combines chemically with these anions. The cathode is never corroded.

For instance, if the electrolyte is common salt dissolved in water, the anions are chlorine, and an iron anode would be corroded, the iron forming ferrous chloride; the cations are sodium, and these would decompose the water and liberate hydrogen at the cathode. With an electrolyte of copper sulphate dissolved in water, and a copper anode, the latter corrodes into copper sulphate and dissolves while metallic copper is deposited upon the cathode. These examples furnish an illustration of the fact that the corrosive action of the current results in supplying the electrolyte with an equivalent to the amount of salt decomposed by the current, so that the electrolyte is continually replenished with salt and its electrolytic conducting power is thereby maintained. This salt will contain the metal ions of the anode, or hydrogen, and may be different from the original salt which started the action.

The rate at which the ions are liberated at the electrodes is proportional to the current strength. With an oxidizing anode, the mass of anode corroded by one ampere in one second, is equal to the electro-chemical equivalent of the metal of the anode. This is 0.00029 gramme for iron (ferrous). From this the mass of iron corroded by one ampere in 1 year is, 0.00029 x 60 x 60 x 24 x 365 grammes, or, 0.00029 x 60 x 60 x 24 x 365 x 0.002205 = 20 pounds (approximately). The electro-chemical equivalent for lead is 0.0010718, and the mass of lead corroded by one ampere-year is, 0.0010718 x 60 x 60 x 24 x 365 x .002205 = 74 pounds (approximately).

The separating of the metal or hydrogen ion from the electrolyte at the cathode absorbs energy from the electric circuit and generally produces an electromotive force in the opposite direction to the current. The oxidation of the anode supplies energy to the circuit and generally produces an e. m. f. in the direction of the current. If an oxidizing anode is of the same metal as is being deposited upon the cathode, and the electrolyte is the same at the anode and cathode, there is no resultant e. m. f. due to the electrochemical actions, and the only e. m. f. consumed is that due to the resistance of the electrolyte in accordance with Ohm's law, exactly as with a metallic conductor.

If the metal deposited at the cathode is different from that oxidized at the anode, or if hydrogen is liberated at the cathode, or if the electrolyte at the cathode is not of the same composition or density as at the anode, there will be a resultant e. m. f. which may be either in the same direction as the current or in the opposite direction to the current.

Street soils generally contain salts, principally chlorides, nitrates and sulphates, dissolved in water, and this makes them electrolytic conductors. It has been claimed by some that soils conduct to a considerable extent metallically; this has, however, been disproved, and it is now understood that soils can only conduct electrolytically. The conductivity depends, then, entirely upon the chemical composition and wetness of the soil, which vary greatly in different localities.

In practically all single-trolley roads the trolley wire is connected to the positive pole of the dynamo, and the rails are connected to the negative pole. In cheaply constructed roads the connection to the rails is only made at the power station, and the rails are, therefore, expected to serve as the return conductor for all current. In order to make the rails a continuous conductor they are bonded at their joints, ordinarily with copper wire.

We will now consider the result of this construction. The rails are in contact with the ground for their entire length, and as the street soil is a conductor, part of the return current must shunt through the ground in accordance with the law of divided circuits. This current, which as it were, leaks from the rails through the ground, is called stray current. In the simple case under consideration (rails connected to the negative pole at station only) the potential of the rails increases with the distance from the station and with the number of cars in operation. Neglecting any slight counter electromotive force, the amount of stray current varies directly with the potential difference in the rails and inversely with the resistance between the point at which the stray current leaves the rails and the point at which it again enters the return conductor. The stray currents would disappear, then, either with zero potential differences in the rails, or, with an infinite resistance to their path, two conditions which are clearly impossible with a single-trolley electric road, and, therefore, stray currents are always produced by such roads. In some electric railway stations the negative busbar is grounded by means of earth plates. Since this diminishes the resistance to the ground, the result of this practice is to increase the stray currents.

If the ground through which the stray currents pass contains metals such as water pipes and gas pipes, which have a high conductivity, these currents will largely pass through such metals. In general, in districts distant from the power house the stray currents flow through the intervening soil from the rails to the pipes; these districts are, therefore, called negative districts and the pipes in them negative pipes. In the district surrounding the power house the stray currents flow from the pipes through the intervening soil to the rails; these latter districts are, therefore, called positive districts, and the pipes in them positive pipes. Between these two districts the stray current flows from rails to pipes or from pipes to rails, depending upon the distribution of cars, etc. These intermediate districts are sometimes called neutral districts.

Since every electric circuit must be completely closed, all current which leaves the plus terminal of the dynamo must return to the negative terminal. For this reason all current which escapes from the rails in the negative district

*A paper prepared for the Committee on Electrolysis and submitted to the American Gas Institute.

and reaches the pipes, must again leave the pipes in the positive district in order to return to the negative pole of the dynamo. The electric current is in this respect very different from gas or water, which latter can leak from a pipe and become diffused through the ground.

With the stray currents in the ground and on the pipes we have, then, the conditions of an electrolytic cell, the pipes and rails being the electrodes, and the dissolved salts in the soil, the electrolyte. In the negative district the current flows from the rails through the soil to the pipes, and the rails (anodes) are corroded, while the pipes (cathodes) are not corroded. The corrosion of the rails does not concern the pipe-owning companies, and they have considered these negative districts as safe districts. In the positive district the current flows from the pipes to the soil and the pipes (anodes) are corroded by the current. For this reason the positive district has been called the danger district.

The reason for connecting the negative, rather than the positive, pole to the rails was to concentrate the positive district within the region surrounding the power house; it was hoped in this way to restrict the pipes endangered by electrolysis to this definite and comparatively small region, so that they could be watched and remedies applied. It has been found, however, that there are many points in the negative and intermediate districts, for instance, at joints, where current may leave a pipe and produce electrolysis.

In most large, single-trolley systems the rails are connected to the negative busbars by return feeders at a number of places besides directly at the power station. At each point of connection of such a return feeder to the rails a positive region is established, and some stray currents will leave the pipes in this region to return to the rails near such points.

The danger region of a piping system is, in fact, by no means confined to the so-called positive districts, but at every point where current leaves a pipe to pass into wet soil, electrolytic corrosion must take place. An iron pipe is ordinarily not in uniform contact with the surrounding soil, owing to high resistance oxide coating, etc., so that the current leaves in spots where there is good contact with the soil. The result of this is that the corrosive action is concentrated at these spots so that holes or pittings are produced by the corrosion.

It has been stated that one ampere-year will corrode 20 pounds of iron or 74 pounds of lead. Secondary chemical reactions may, however, greatly increase this amount of corrosion. It must also be understood that this 20 or 74 pounds of corrosion occurs at every point at which the current leaves the pipe for wet ground, and that the same ampere of stray current can leave and again return to a pipe any number of times in its path, depending upon the electrical conditions; so that any number of times 20 or 74 pounds of corrosion may be produced by a single ampere of stray current in 1 year.

It has been shown that a small fraction of a volt (Jackson says "a mere directive force, in the nature of a pressure") will produce enough current to cause electrolysis with the conditions generally present with underground pipes. This has been proven experimentally by a number of investigators, notably by Jackson (1), Fleming (2) and Larson (3).

The published results of some laboratory tests with alternating currents seem to indicate that these may also produce electrolysis, the extent of which is probably a small fraction of that produced by an equal direct current. Alternating currents would, however, corrode both electrodes. Electric trolley roads have only very recently begun to use alternating currents, and, so far, no practical experience has been furnished from which it can be concluded whether electrolytic corrosion is practically negligible or not. It is, therefore, not safe to assume, as some writers have done, that the substitution of alternating for direct currents on single-trolley roads would eliminate electrolytic troubles.

It is clear from the foregoing that the electrolytic corrosion is produced where the current passes from a pipe to wet soil, and that the amount of corrosion depends upon the strength of the current and the time during which it acts. The fact that a pipe is positive to some other conductor is not in itself evidence that electrolysis is taking place; there must, in addition, be an electrolytic conductor, in the nature of wet soil, between the pipe and the negative conductor, so that the potential difference can cause a current to flow from the pipe to the soil. The smallest quantity of a soluble salt in this soil is sufficient to start the corrosion, and this action of itself replenishes salt required for electrolytic conduction, as shown before. A high potential difference may, even under certain conditions, indicate a high resistance and a correspondingly small current with little corrosion, while a low potential difference may indicate a low resistance, and a large current with a correspondingly large amount of corrosion. Electrolytic surveys which consist only of voltmeter readings are, therefore, not sufficient to determine the existence and extent of electrolytic corrosion. Direction and strength of current flow in various parts of the system are required in addition to the voltage readings.

1. "Corrosion of Iron Pipes," by Prof. D. C. Jackson, "Journal of the Association of Engineering Societies," September, 1894.

2. "The Electrolytic Corrosion of Water and Gas Pipes by the Return Currents of Electric Tramways," by Dr. J. A. Fleming, "The Electrician," London, September 16, 1898.

3. "Electrolytic Action of Electric Current Upon Iron Pipes in the Ground and the Resulting Polarization," by Prof. A. Larson, American Water Works Association Proceedings for 1903.

THE METAL ALUMINUM.

It is of interest to remember that, nearly a hundred years ago, Davey dissolved alumina, but failed to isolate the metal, although he named it. It was not until the year 1855 that the French chemist, Deville, showed that aluminum could be prepared on a large scale and in a compact form without very much difficulty. Although the mineral cryolite, which is found in Greenland and is a double fluoride of aluminum and sodium, was the one first used for the manufacture of aluminum, nowadays bauxite is used for the purpose. Bauxite is a clay consisting chiefly of alumina or oxide of aluminum, and oxide of iron. Electrolytic methods are employed in the preparation of the metal, and full advantage is taken of the hydraulic power at Neuhausen, and, on a larger scale, at Niagara, to obtain the current necessary. Aluminum is very malleable and ductile, and in tenacity it approaches iron. It fuses at about 700 degs. C., and does not oxidize. It has been known for some time that aluminum forms suitable alloys with copper, although the above-mentioned reports place the properties of all of these alloys on record for the first time. Aluminum appears to alloy with tin, and has been used for optical instruments, and it is therefore possible that further research will be done on aluminum and copper alloyed with tin.

PRIVATE TELEPHONE FOR A PRISONER.

Several centuries ago an English poet who was sent to prison wrote that bars and locks cannot confine the man whose mind is free and unfettered. Doubtless the same thought has led a white woman confined in an Alabama county jail for manslaughter to demand a telephone in her cell. Yohlande Degg is the prisoner and she has appealed for a new trial to overthrow the sentence which imposed a penalty of twenty-three years' imprisonment. Having powerful friends, she obtained many favors denied the ordinary prisoner, and one of her requests was to have a telephone in the cell for her personal use. It was granted her after some delay, and now she can call up and talk with all her old friends who have not dropped her from their list of acquaintances. This is believed to be the first case on record of a convicted prisoner being allowed a private telephone.

FLEXIBLE CORD MUST BE TESTED.

After several meetings of the joint committee formed by representatives of the insurance interests and the advisory committee of the flexible-cord manufacturers, it was deemed advisable to devise ways and means of testing all flexible cord, both pendant and portable, manufactured under the rules of the National Board of Fire Underwriters, as recommended by the Underwriters' National Electrical Association. This is to restrict the introduction into commercial use of any cord which would prove inferior to the National Electrical Code standard, so as to protect reliable manufacturers against inferior goods, in competition.

Specifications for these factory tests have been drawn up by the committee and are as follows: "Each coil of duplex cord shall be tested dry by the application of 1,500 volts alternating current simultaneously to each of the two conductors, contact being made on bare copper wires at either end of the coil, and care being taken that the other ends of the conductors do not come together. Alternating current is to be supplied from a transformer with an actual working capacity of at least five kilowatts."

These factory tests will be conducted in a similar manner to those now carried on under directions of the Wire Inspection Bureau in the manufacture of National Electrical Code rubber-covered wire.

Stamps will be issued by the Wire Inspection Bureau and sold to the different manufacturers at a charge of 2½ cents per thousand running feet of cord tested. These stamps are to be attached to the coils of tested cord by the manufacturers themselves, and are to serve as a guarantee that cord so stamped has successfully withstood the tests specified by the bureau. They will be furnished for 250-foot, 500-foot and 1,000-foot coils, as desired.

The majority of flexible-cord manufacturers have recently agreed that on and after March 1, 1907, all National Code cord manufactured by their companies shall be made up under the new specifications and duly tested, and will bear identification mark of the Wire Inspection Bureau.

It is understood that a reasonable time will be allowed, after the date mentioned, for the disposal of Code cord not bearing the stamp of approval of the Wire Inspection Bureau, on all such cord manufactured before March 1, 1907, and with this understanding, the April list of "Electrical Fittings" will contain the names of flexible-cord manufacturers agreeing to the tests of the Wire Inspection Bureau and using stamps as guarantee that these tests have been properly made.

No cord will be considered as having been tested which does not carry an identification stamp. Stamps are to be securely fastened to the shipping tags attached to the coils. All stamps are to be canceled by the manufacturer when used, the date of manufacture of cord, also, being plainly shown.

Hugh T. Wreaks, 43 Cedar street, New York City, is secretary of the Wire Inspection Bureau, and it is from a circular issued by him that the above information is obtained.

In addition to furnishing gas and electric light free to aid the work put upon the Relief Committee of Cincinnati, O., brought about by the extremely high water mark in the river, the Union Gas and Electric Company has forwarded to Mayor Dempsey a check for $500 for the fund for the relief of those who suffered by the flood.

THE BUSY SIGNAL.

Many telephone subscribers entertain a grudge against the "busy" signal that is ill-founded. It is natural, perhaps, for one to become impatient on hearing the "nothing doing" buzz when he is in a hurry to obtain the desired connection, and some often suspect that the signal is given because the operator at central is negligent and careless and anxious only to get rid of the call. The truth is, however, that the busy signal is considered by telephone experts as one of the best time-savers devised in the development of apparatus. In fact, the signal was invented for the purpose of saving the time of both the subscriber and the operator. It facilitates the work of the operator by doing away with the necessity of informing the caller that the line is busy, saving the operator the time consumed in this way, enabling her to give other callers quicker service in answering when the board is busy.

It also saves time for the caller, as the moment he hears the buzz he knows that the line is busy without waiting to be told.

Many subscribers have got the idea through frequently hearing the buzz that it is the fault of the operator who does not care to take trouble to make the connection. The fallacy of this impression is shown by the fact that it is more trouble for the girl to give a busy signal than it is to make the connection.

Prompt and efficient service by the operating department is the foundation of success of a telephone company, and great care is observed to see that the operators at the switchboards give as little cause for complaint as possible. A strict surveillance of their work is maintained at all times. In all large exchanges every girl is required to answer every call and try to get the party asked for. A supervisor stands constantly back of the girls at the switchboard watching their movements and seeing that they give quick service. In addition to this a girl is seated at the "supervisory board" who can get in on any line and hear what the operator is doing.—Telephony.

HYDRO-ELECTRIC PLANTS OF UNITED STATES, CANADA AND MEXICO*

Under the title "Hydro-Electric Plants of the United States, Canada and Mexico," Arthur W. Clapp, M. E., E. E., 1164 Monadnock building, Chicago, Ill., will shortly give to the electrical engineering field the first volume of one of the most exhaustive treatments of this branch of the electrical industry that has been published for some time. Every plant of over 500 horsepower capacity, in the countries covered, will be described with the object of laying before the profession the intimate details of each hydro-electric power plant, its equipment, its location, its purpose and unique features.

The author announces that but few of the plants described in this work have ever appeared in print of any form; and the manner in which the matter is presented in the separate articles will bring the subject vividly before the reader.

The work will be in two or more volumns of 500 pages each. Each plant described illustrated with photographs grouped on one page. The description of the plant gives the following subjects in detail: Hydraulic features, construction of dam and power house, detail of electrical and switchboard equipment and pole line, each article consisting of from 3,000 to 5,000 words. There are in all about 350 hydro-electric plants of over 500 horsepower in the countries above mentioned. To date about 250 have been described in the material received.

Accuracy as to data furnished will be the main feature of the work, the statistical matter being furnished by engineers now in control of the individual plants or by those under whom the plant was constructed. Before publication final proofs will be submitted to each company operating the plant described for correction.

This work to the extent of 2,500 copies is to have a free distribution among the electrical engineers in charge of the plants described and to those parties who contemplate the erection of hydro-electric plants. This distribution is made possible by the co-operation of a number of companies who are interested in the manufacture of hydro-electric equipment. A compilation of this character will be of great assistance as a reference book for years to come, and the author will be pleased to receive any information or statistics that will be of interest to the profession and valuable for publication of these volumes. As there will be an excess of a few copies of this work, Mr. Clapp will furnish gratis a complete set of the volumes to any reputable engineer or company upon application.

*Reprint from Vol. 16, Page 242, issue out of print—by request.

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VOL. XVIII FEB. 16, 1907 No. 7

EDITORIAL.

Conservation Charges by the Forest Service

We are glad to publish in another column of the "Journal" two letters from Mr. G. W. Woodruff, chief law officer of the Forest Service, which letters treat of the proposed charge against hydro-electric power companies for the use of Forest Reserve land. Mr. Woodruff's letter of January 28th refers to the editorial which appeared in the issue of December 22, 1906, of the "Journal."

It can hardly be said that the letters of Mr. Woodruff contain any new matter not found in the circular letter entitled, "Memorandum Concerning Conservation Charge," which was sent out by the Forest Service in November, 1906, and which we also publish in this number. There are certain statements made by Mr. Woodruff, however, which we most respectfully desire to discuss.

It is said that on May 31, 1905, the Attorney-General sent the Secretary of Agriculture an opinion to the effect that it is legal for him to charge for any use of Forest Reserve land products or resources granted exclusively to individuals or companies as against the rest of the people.

We believe that no one will object to a charge being made if such charge is based upon the above regulation or requirement. The truth is, however, that there is probably not a single hydro-electric plant in the United States that actually uses an acre of Forest Reserve land exclusively as against the rest of the people, unless it be, perhaps, the small area required in some instances for a power station building, for which power house site the company would be glad to pay to the Government either a proper rental or recompense the Government in any other way the Forest Service should dictate.

When a reservoir is constructed upon Forest Reserve land by a power company, the storing of this water is a decided advantage to all of the people of that particular district, and especially to the agricultural interests in the valleys below. If the Department of Agriculture had unlimited means at its disposal, large sums would undoubtedly be expended for the construction of just such reservoirs as are built by the power companies. Further, the more reservoirs that are built, no matter by whom, for the storage of the winter floods, the greater will be the productiveness of the lands in the valleys below.

Nor are such reservoirs exclusive—not only the power companies, but everyone else, would welcome the building of other reservoirs. The more that are constructed, the greater will be the benefits to all.

The roads which have been built on Forest Reserve land by the power companies are not exclusive. They are, in fact, public highways, well built at heavy cost to the hydro-electric companies, and are in almost every case kept in repair by the builders. Neither is a ditch line or pole line exclusive. There may be other lines belonging to other companies, in fact, as many as are needed. No power company desires to exclude anyone from the Forest Reserve. To compare the purposes of the power companies to the actual and exclusive use of Forest Reserve land by railroads, owners of live stock and others, whose occupation of the land is exclusive, is manifestly not only unfair but absurd. We are most firmly of the opinion that the power companies ask no privileges that are exclusive or which are against the interests of the people at large.

Our Forest Service friends evidently believe thoroughly in the convincing ability of the word "reasonable." It is of importance to note, however, that no one outside of the Forest Service will, or by any possibility can, have an important part in the decision of what is or is not a "reasonable" charge.

The first two of the three charges proposed, viz.:

First, a reasonable charge per acre for the ground actually occupied by other than lines, and

Second, a reasonable charge per mile for lines such as transmission, pipe, ditch, canal, tramroad, etc., would undoubtedly be cheerfully accepted by the power companies if such charges were definitely fixed and reasonable, taking into consideration the fact that the occupancy of Forest Reserve land for reservoirs, highways, trails and pole line clearings, which last, as has been pointed out, are the best of fire breaks, is of enormous value to the Government and to the people, as well as of value to the power companies.

The so-called "conservation" charge is, however, neither reasonable, rational, sensible nor justifiable.

If, as the Forester asserts, the Government, by maintaining a forest cover upon the watershed above the intake, furnishes an actual value to the power company, because the forest floor and conditions conserve the water and regulate the flow in a way which otherwise must be done by costly reservoirs, then to be consistent, every user of the water coming from this watershed for the irrigation of land or as a domestic water supply, or for any purpose whatsoever, should also be required to pay a conservation charge to the Forest Service, and what is more important, when a power company builds costly reservoirs, both the Government and the users of water below should recompense the power company for conserving the water and regulating the flow with reservoirs, since the result is the same as when the forests are preserved over the upper watershed by the Government through the Forest Service.

Finally, to use as a measure of the conserving effect of the forest maintained by the Government, not only the amount of water used, but the fall or head as well, is unreasonable from any standpoint. The amount of electricity produced is rarely with any power company a measure of the so-called conservation by the Government, due to the maintenance of forest-covered watersheds. The amount of electricity produced might depend very much more upon the reservoirs constructed by the power company than upon the maintenance of a somewhat uniform flow due to the preservation of the forests.

It is said that the present Forester certainly will make no charge high enough to cause a prudent business man to hesitate about taking out a new permit or continue to operate under an old one. Further, that every company will be given an agreement which will be binding for a series of years, as far as the Forest Service is concerned, but will not limit the life of the permit itself, and, finally, it is said that the objection to the payment of the proposed charges is merely the natural aversion which all people have to giving up money so long as there is a chance of holding it.

To all of the above we wish to say that the proposed conservation charge is excessive, being practically a confiscation of three per cent of the gross income of the companies, and the fact that this charge may be certain makes it all the more burdensome. We further believe that the Forest Service officials would also have a natural aversion if all of their appropriations were subject to a reduction of three per cent in the interests of those for whom the work of the Forest Service is of the greatest benefit.

CORRESPONDENCE.

As mentioned in our editorial columns this week, we are in receipt of two letters from the chief law officer of the Forest Service, which we publish below with the consent of the writer. We believe that our readers will also be interested in the circular letter of the Forester, sent out from Washington in November last, to the electric power transmission companies of the Pacific Coast.

UNITED STATES DEPARTMENT OF AGRICULTURE FOREST SERVICE.

Washington, January 28, 1907.

Editor Journal of Electricity, Power & Gas, 606 Mission Street, San Francisco, Calif.

Dear Sir: My attention has been called, somewhat late, to the first editorial in your publication of December 22, 1906. The Forester is away from Washington, and I therefore hasten to send you copy of a letter written on the question of the "conservation" charge, which will explain some of the matters touched on in your editorial, concerning which you did not have full information at the time.

It will explain the Forester's intention when only a part of the plant is in the forest reserve.

It also explains the method by which the Forester intends to make charges certain, and that he will exercise the utmost care to make them reasonable, in order to avoid either prohibiting the development of electric powers or confiscating plants already constructed.

I hope the crude points contained in the enclosed letter will appeal to you as part of the entire defense which could be made to show the justice of the proposed "conservation" charge.

If the proposed maximum charges, which were put forward for consideration to the hydro-electric companies rather than as final, are shown to be too great, the Forester will certainly reduce them. Very truly yours,

(Signed) G. W. WOODRUFF, Chief.

UNITED STATES DEPARTMENT OF AGRICULTURE FOREST SERVICE.

Washington, January 29, 1907.

Mr. Philip W. Ayres, 7 Park Ave., Winchester, Mass.

Dear Mr. Ayres: Your letter of January 17 has remained unanswered because of rush of business. Your reminder about the getting together of the Governors, etc., came in very handily, because Governor Glenn's train was very late, and he telegraphed to the Forest Service for instructions.

Concerning the charge to hydro-electric power companies for rights of way and privileges within the forest reserves, I am very glad to give you complete information to forward to Governor F. W. Rollins.

On May 31, 1905, the Attorney General sent the Secretary of Agriculture an opinion to the effect that it is legal for him to charge for any USE of forest reserve land, products, or resources granted EXCLUSIVELY to individuals or companies as against the rest of the people. There is no thought of charging for ordinary and general use, such as hunting, fishing, camping, traveling, etc. The reserves are considered by the Forester to be the property of all the people, and so long as any of the people wish to use this common property in a way which is neither PERMANENT nor EXCLUSIVE, the Forest Service is simply their *servant* to protect their property, make it accessible, improve it, and even give advice as to desirable places for camping, etc. All this is done gladly and freely.

When, however, a man wants to build a small hotel, to turn his cattle in to graze the forage, to cut timber other than the small quantities needed for building and fuel purposes by settlers, to construct and maintain reservoirs, canals, ditches, pipe lines, transmission lines, power-houses, etc., the Forester, following the Attorney General's opinion, is making a reasonable charge for such exclusive use.

Congress has provided that the money received from such charges shall become a special fund for the "administration, protection, improvement and extension of forest reserves." This fund has been, in my opinion, the salvation of the forest policy in the United States. Congress would not have appropriated sufficient money to maintain the necessary field force to protect

the people's property; but from the charges, which amounted to $767,000 last fiscal year, and will be $1,250,000 this year, the Forester has been able to gradually lift the field force both in numbers and quality above the ruinous minimum.

There have been grumblings about these charges. This is natural. Every business man considers that any saving in expense is so much advantage to him. Owners of live stock paid in over half a million dollars last fiscal year with considerable reluctance, but are now, in the main, glad that the charge is being made.

The first people to make a decided and continued objection were the hydro-electric power companies of which the Edison Electric Company is one of the permittees involved. The proposed formula to determine the rate of charge in all privilege cases had been fixed for convenience and uniformity as follows: It was assumed that any or all of three elements might enter into any privilege charge. They were:

(a) A reasonable charge per acre for the ground actually occupied by other than *lines.*.

(b) A reasonable charge per mile for lines such as transmission, pipe, ditch, canal, tramroad, etc.

(c) A reasonable charge, measured by some certain and convenient method, for any resources, opportunities, or services furnished by the government to the permittee besides "area" and "length." This, for convenience, is called "conservation."

The hydro-electric companies did not object any more seriously to "(a)" and "(b)" than other permittees who would prefer to have such expense, but they claimed, and still claim strenuously that the United States does not furnish, in addition to area and length, that which the Secretary of Agriculture and the Forester claim it does.

The Forester asserts that the government, by maintaining a forest cover upon the watershed above the intake, furnishes an actual value to the permittee, because the forest floor and conditions conserve the water and regulate the flow in a way which otherwise must be done by costly reservoirs. He claims that the amount of water used (although there is no thought of charging for it, since the water is granted directly by the State) is nevertheless a proper *measure* of the conserving effect of the forest maintained by the government.

He also claims that the fall, over which the pipe or ditch is carried, is a resource or element furnished by the government which enter directly into the production of electrical energy. Without the fall, the water granted by the State and owned by the company would be of absolutely no value for generation of electricity.

Therefore, if as the Forester claims, the water is conserved and the fall is furnished by the United States, and as the Attorney General asserts it is proper for the Forester to make a *reasonable* charge for what the Government furnishes, it follows, as a matter of course, that the electricity produced is a *measure* of the two elements which enter into it, namely, the water conserved and the fall furnished.

Therefore, the Forester has announced to the electric companies that they must pay for "conservation," either by an annual flat rate advance payment per theoretical horsepower (this alternative maximum rate was proposed to be 75c) or by a rate per electrical unit developed (this alternative maximum rate was proposed to be 20c per thousand kilowatt hours).

There are two additional considerations in these charges which the Forester wants to call particularly to the attention of all interested persons:

(1) The proposed alternative maximum rates would be reduced proportionately if any part of the watershed above the intake were not forest reserve land, and if any part of the fall furnished is outside of the forest reserve. There are several combinations which would be considered under this heading, and in most cases would result in a reduction of charge.

(2) The Forester understands that the very life of business demands that charges must be *certain.* The companies complained that, even though the present Secretary and Mr. Pinchot might be trusted to refrain from increasing the charges to the point of confiscation, some socialistic change in the government would endanger the complete loss of their property. To meet this the Forester has recently evolved an adequate arrangement. Every company will be given an agreement which will be binding for a definite number of years upon successive administrative officers, but will not limit the life of the permit itself to any number of years, leaving that necessarily to the effect of the law under which each privilege was obtained. The charges for that period will be made definite.

(1) By fixing the initial rate of charge definitely in the agreement.

(2) By providing that the charge may not be increased for five years after first payment, nor thereafter in any period of five years more than a definite percentage, say one-fourth.

(3) By fixing some definite number of years to be arranged by conference with the separate permittees (say forty) during which the agreement concerning charges shall be binding on the government, and during which the maximum charge shall not be greater than a definite maximum rate, even though the increase by periods of five years should bring it to that maximum before the end of the entire agreement period.

By studying this arrangement of charges carefully, a business man can see that certainty as to maximum can be ascertained. He will always have the chance, by showing that the increase would undoubtedly be burdensome, to hold the payments below the possible maximum. The present Forester certainly will make no charge high enough to cause a prudent business man to hesitate about taking out a new permit or continuing to operate under an old one. The restrictions as to maximum will protect permittees to that extent against future administrative officers, and besides they can naturally have the reasonable expectation that such officers will exercise good sense and deal justly with the users of government resources.

I am sure that you, from your intimate acquaintance with Mr. Pinchot, will know that he is not doing anything that he does not consider just and fair. That the charges are not prohibitive is shown by the fact that new applicants do not hesitate to agree to accept them, provided that the same rates of charge are made to others who will be in the same business. Frankly speaking, the objection to the payment is merely the natural aversion which all people have, to giving up money so long as there is a chance of holding it.

Governor Rollins need have no fear whatever that the investments in which he is interested will be prejudiced by any action of the Forester. Mr. Pinchot has agreed to refer the conservation charge feature to the Attorney General for a further opinion before proceeding to fix and collect such charges. Very sincerely yours,

(Signed) G. W. WOODRUFF, Chief.

MEMORANDUM CONCERNING CONSERVATION CHARGE.

After careful consideration the Secretary of Agriculture has decided to place all permittees upon forest reserves, whose permits involve the generation of electricity by the use of water, in the same position as to a definite and reasonable annual charge to represent "conservation;" by which is meant anything furnished by the government to the permittee besides the area of ground actually occupied by reservoirs, power plants, etc., and the *length* of line actually occupied as a right of way. In the case of electrical plants the Secretary believes that the proper *measure* for a conservation charge is the amount of water used and the fall furnished. The Secretary does not charge for the water itself which, he recognizes, is granted directly by the State. He merely uses the water as a *measure* of the conserving effect of the maintenance of the Forest Reserve.

The water used and the fall result in horsepower. For this reason it was originally intended to make an annual charge of seventy-five (75) cents for each theoretical horsepower to be developed by any permitted electrical plant. The Secretary, however, upon representations by interested permittees, has decided to go one step further for the measure of conservation,

namely, to the meter which shows the amount of electricity actually developed. The proposition is to have a responsible Forester officer read this meter from time to time and report the electrical energy indicated upon it. This reading will be made in the presence of the company's foreman, and payment will be required at the rate of twenty cents per one thousand kilowatt hours. The Secretary plans to have this conservation charge take effect from the date upon which any plant is actually put into operation, but in no case to make it retroactive beyond July 1, 1906.

I recently informed one or two interested permittees of this plan for fixing the conservation charge, and have received many telegraphic requests to defer final action until a hearing upon the merits of the cases; but I realize that a general hearing would not be satisfactory from every standpoint, unless after the discussion of this question by individual permittees. For this reason I am sending to interested permittees an exact statement of the charge and the theory upon which it is based. I will be glad, if you desire, to have you write to me frankly and in detail on this matter, giving me information, if you are willing, on the following points:

1. What fall will you use in generating electrical energy under your permit?

2. What part of the conduit involved in this fall is actually situated within the Forest Reserve?

3. What number of cubic feet per second do you plan to run through your penstock when your electrical plant is running full capacity?

4. What class of water wheel do you intend to use?

5. Would you, as a practical matter, prefer paying a charge of seventy-five cents per theoretical horsepower as compared with a charge of twenty cents per one thousand kilowatt hours read from the above meter?

Note, that the charge per kilowatt hour would result in no charge whatever when you are unable to run for any reason, and would never involve a charge except for electrical energy which, for business reasons, you actually chose to develop.

6. Is it safe for the Forest Service to accept the reading of the meter at the transformer, as showing all the electrical energy developed at any particular plant? This question is asked because of the untechnical person's fear that in some way some of the electricity could be led by the meter and returned to the current beyond.

7. In detail, what loss of energy do you expect between the water wheel and the consumer, and what causes each item of loss?

8. What is the greatest distance to which you will transmit the electrical energy, and what is the average distance?

9. What kind of wire do you expect to use for transmission purpose?

10. What has been or will be the entire construction cost of your plant (or plants, if you have more than one) with details as to the different portions of the project? For example: (a) dam for storage purposes, (b) intake dam and headworks of canal, (c) ditch or other open water conduit, (d) pipe line used to carry water for definite power-producing purposes, (e) wheels and fittings, (f) power station, (g) pole line, (h) transmission circuit, (i) dynamos and equipment, (k) transformers, (l) distributing lines, (m) miscellaneous.

11. What do you estimate will be the actual operating expense of your business per year, with as much detail as you are willing to give?

12. What per cent. of the actual construction cost do you believe should be set aside each year, to represent deterioration of plant?

13. For what purposes are you selling or do you expect to sell the electrical energy, and what portion for each purpose?

14. How much do you get or expect to get per one thousand kilowatt hours for each purpose?

I recognize that for business reasons, the annual charge to any permittee should either be a fixed sum (like that of seventy-five cents (75) per theoretical horsepower), or a determinable sum, charged from time to time upon your actual production, and am convinced that the charge to be determined from your meter would make it possible for you to prove to any intelligent prospective investor the maximum cost to you per year as conservation charges, and that you should be able to convince him without difficulty that the heavier the payment to the Forest Service during any one year, the greater the profit to those interested in the project, because the charge would be paid only on electricity actually developed for sale and after the permittee has had opportunity to dispose of it for cash.

The Secretary is sure of his right to make this conservation charge, but will certainly make it a reasonable one. The questions in this memorandum are asked particularly to obtain data to ensure reasonableness of charge.

I would be glad to receive an early reply to this memorandum, because I want to hear from the Forest Reserve permittees of this class before sending to them the Secretary's final decision concerning conservation charges. Even if you want a personal hearing it would be to your advantage to answer this memorandum first to save time both for yourself and the Forest Service. Your reply to these questions will be treated confidentially and as for the use of the Forest Service only.

November 28, 1906.

BOOK REVIEWS.

United States Department of Agriculture, office of Experiment Stations, Irrigation and Drainage Investigations, Bulletin 177, Losses of Water by Evaporation—During the past few years experiments have been made by the office of Experiment Stations in co-operation with the State of California to measure the losses of water by evaporation from irrigated orchards in California, and to determine the effectiveness in checking these losses, of various methods of applying the water, and of cultivation after irrigation. The experiments included applying the water at different depths, varying from the surface to two feet, and of cultivation at varying depths, showing in every case a noticeable decrease in evaporation with increase in depth of applying the water and of cultivation.

Application for this bulletin should be made to the Director of the Office of Experiment Stations, Washington, D. C.

TRADE CATALOGUE.

General alternating current data are given in Bulletin 74, just published by the Crocker-Wheeler Company, Ampere, N. J., entitled "Engine Type A. C. Generators." This gives the bulletin value for all who have to do with alternating current. A number of views are shown of plants where Crocker-Wheeler alternators are installed, and the bulletin also goes into details describing the design of generators developed by the company. C-W engineers began designing A. C. machines about three years ago, when the company had had fifteen years of highly successful experience in D. C. design and manufacture. They based their work upon the designs of the celebrated Swiss electrical engineers, Brown, Boveri & Cie, acting under license from the Swiss firm. They therefore entered the field of A. C. manufacture unhampered by a costly stock of old designs, drawings and patterns, and were able to incorporate new and useful ideas in this class of machinery. The company met with instant recognition in this field and has accomplished remarkable results, especially in plants where the generators are driven by gas engines. One of the marked peculiarities of C-W alternators is their ability to operate in parallel; it was largely for this reason that the California Gas & Electric Corporation installed three 4000 K. V. A. Crocker-Wheeler alternators in its San Francisco plant. These are the largest generators ever built for gas engine drive.

The Association of American Portland Cement Manufacturers have sent out the first issue of a very attractive little folder to meet the growing demand for reliable information regarding the proper use of Portland cement. According to their announcement, it is the intention of the publishers to have original articles from the leading exponents of the various phases of the work.

INDUSTRIAL

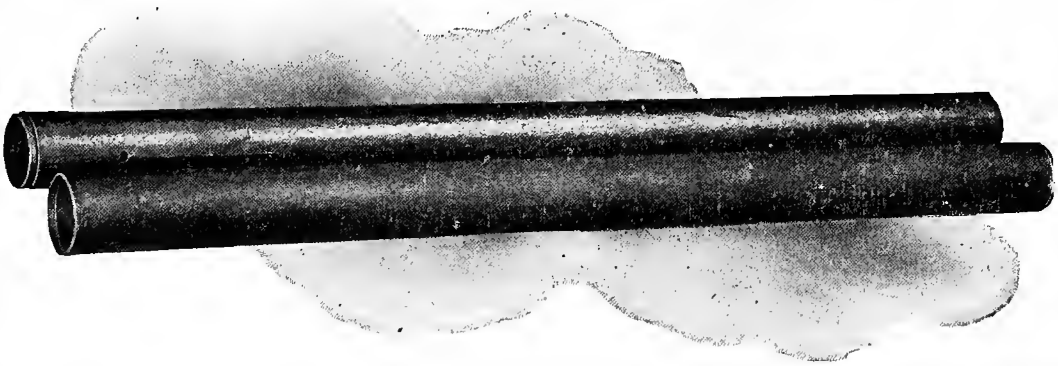
FIBRE CONDUIT: ITS MANUFACTURE AND USE.

In designing an underground system for Telephone, Lighting or Street Railway Conductors the engineer is at the outset confronted by the problem of the character of material which shall surround the cables. His choice is limited under ordinary conditions to one of three possible materials. Depending upon the proximity of a tile manufacturing plant, earthenware naturally would probably be first considered. Up to within the last five or six years earthenware was about the only material that could have been used.

Wooden ducts with grooves hollowed out to receive the cable are a possibility which, depending on the location, might be given some consideration.

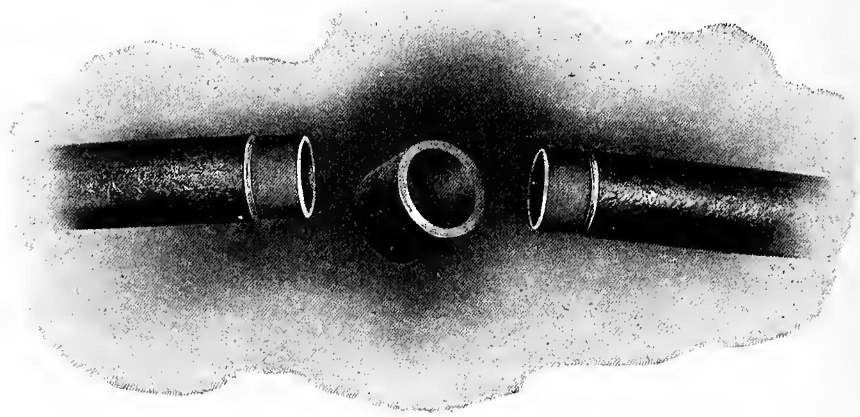
Finally a body of concrete properly laid with the necessary ducts may be considered, provided the ducts can be lined with a softer material than concrete, which, at the same time will act as forms so that the concrete work may be easily and cheaply done. Such a material is offered under the name of Fibre Conduit, and this material has numerous advantages that may be studied with interest. Tile may or may not be laid in concrete, but if so laid, dependence is not placed entirely upon the concrete. A Fibre Duct must necessarily depend upon its concrete surrounding, and consequently in the examination of the Fibre Duct it must be considered in connection with concrete under ordinary circumstances.

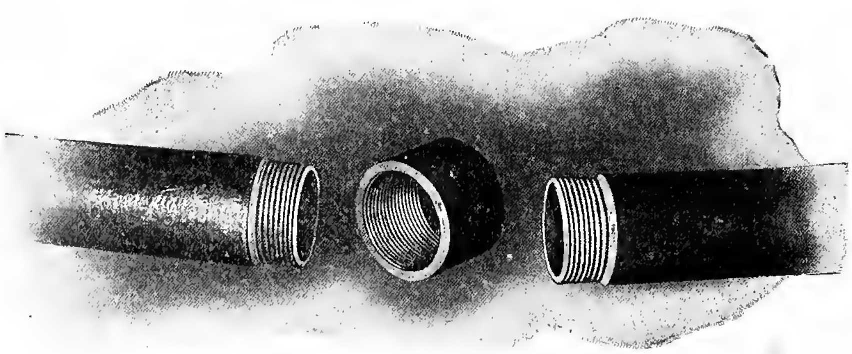
A proper study of the particular conditions pre-supposes a knowledge of the character of the Duct product. In the process of manufacturing Fibre Conduit, wet wood pulp or fibre, is wrapped in a minutely thin film upon a forming mandrel, under pressure, until the desired thickness of wall is obtained, the individual fibres becoming inseparably united and forming a solid wall that s practically homogeneous. Taken off the mandrel, the wet pulp structure is subjected to an air drying process, after which it is placed in a vat of liquid compound. This compound is both preservative and insulating. It thoroughly permeates the entire structure so that after treatment the wall of the conduit, upon cutting, presents a strong resemblance to hard rubber. The ends are cut in a lathe to make a Socket Joint, Sleeve Joint or Screw Thread, as may be desired.



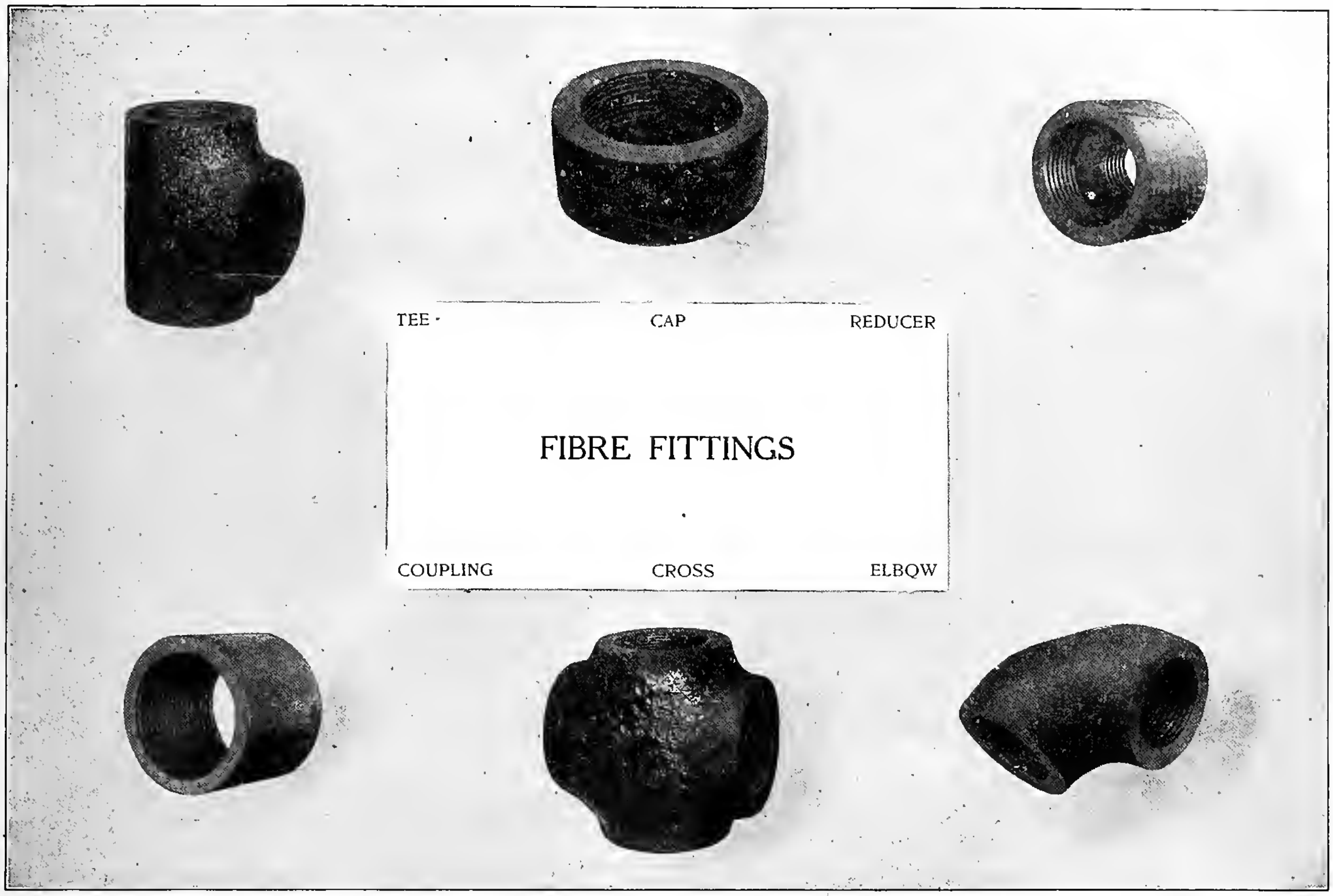
SOCKET JOINT
FIBRE CONDUIT

SLEEVE JOINT
FIBRE CONDUIT





SCREW JOINT
FIBRE CONDUIT



THE SOCKET JOINT TYPE.

The socket or slip connections that are cut on the ends of each length of Socket Joint Fibre Conduit are automatically turned, being ⅜ in. long, slightly tapering and uniform in size. As the joints are automatically formed, the connection secured in laying the conduit is perfect in fit and alignment. The inside of the joint is reamed during the process of cutting so that there can be no off-set at the joints when laid.

THE SLEEVE JOINT TYPE.

In this type of Fibre Conduit, the ends of each length are turned down to fit snugly in a sleeve by means of which a water-tight connection is made. The ends of the pipe are squared and faced, which assures a tight fit. This sleeve is about four inches long and has a wall, approximately, ⅜ inch in thickness.

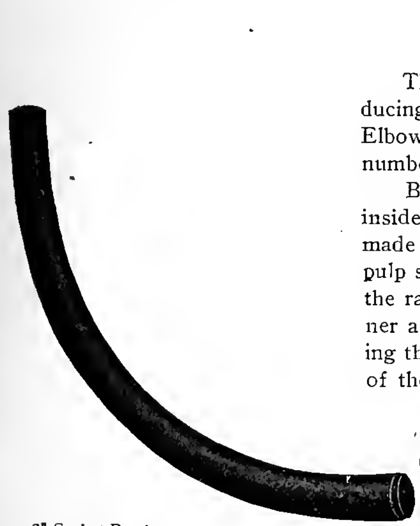
SCREW JOINT FIBRE CONDUIT.

This type of Fibre Conduit is manufactured with a slightly thicker wall than the Socket Joint type, owing to the necessity of securing a sufficiently heavy structure for carrying the thread that is cut on the ends of the pipe. The thread is "United States Standard"—four to the inch—and a coupling is provided for completing the joint. The ends of the pipe are squared and faced, thus assuring a perfect fit, one pipe against the other, when connected. The joints are screwed up by hand, no tongs being used. A liquid compound is furnished by the manufacturer to be wiped on the thread of the pipe when making the connection. This compound hardens and renders the joint absolutely water-tight.

BENDS.

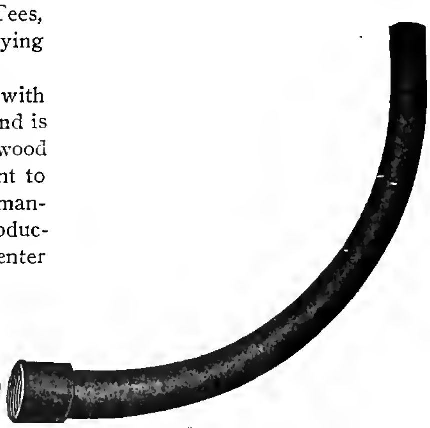
The same materials and general process are employed in producing Bends of various degrees and radii, "S" Bends, Tees, Elbows, Crosses, Couplings and Junction Boxes with the varying number of outlets.

Bends are made two and one-half and five feet long, with inside diameters of 1", 1½", 2", 2½", 3" and 3½". (The 1" Bend is made in 2' 6" lengths.) In producing these bends, the wet wood pulp structure is fitted on a wooden form which has been bent to the radius and degree desired. It is then dried in the usual manner after which it is saturated in the liquid compound. In producing the bends of short radii, the bend is made either at the center of the pipe or near the end.



3" Socket Bend.
90°--36" Radius.

3" Socket Bend—" S " Type



3" Screw Bend with Coupling.
90°--36" Radius.

JUNCTION BOXES.

Fibre Junction Boxes are absolutely watertight and can be used with either Screw, Sleeve or Socket Joint Conduit. They are especially recommended for service connections and where it is necessary to light up private roads. These boxes are made two, three and four-way. The inside dimensions are, approximately, 8x8 inches and the weight is 16 pounds.

FIBRE FITTINGS.

In planning an underground conduit system, one of the most important points to be considered in selecting the material to be used is that which relates to the method of connecting one length of conduit to the next. The importance of this point lies in the fact that upon the method used depends the alignment of the completed system; the degree to which it may be made proof against water and gases; and also, the degree to which it will protect the cables from abrasions and cuts when drawn across the joints. In addition, the method of making the joint increases or decreases the cost of installing the conduit, depending of course on the type of conduit material used.

The method pursued in joining clay conduit, unit to unit, is either to butt the ends of the conduit together, wrap the joint with burlap, and bind with cement mortar; or, connect the units by means of dowel-pins, then wrap with burlap and bind with cement mortar. These methods are the best that can be employed where a clay conduit is used, but from a mechanical standpoint they do not lend sufficient strength to the conduit structure, and any settling of the ground around the system will throw it out of alignment, and will in all probability lock the cables firmly within the ducts, or will prevent the drawing-in of cables.

In considering the various methods of making joints in conduit installation, the connection as made with the Socket Joint type of Fibre Conduit is ideal. The male and female joints that are automatically turned on this type of conduit are so accurately cut that it is only necessary to push one within the other to secure absolute and permanent alignment, and without the use or a coupling compound, form a water-tight and gas-proof connection. Unlike the method pursued in laying clay conduit, it is not necessary to use a mandrel to secure alignment, neither is it necessary to wrap each joint with burlap to keep the concrete from seeping through the joints to the interior of the duct.

While laying a system of Fibre Conduit, employing the Socket Joint type, construction forces have found that the installation of the material proceeds usually at twice the speed required to lay other types of conduit and often times Fibre Conduit is laid even faster.

Besides the advantage in joining Fibre Conduit there are numerous other considerations that should influence the problem. Owing to the extreme lightness of Fibre Conduit, the expense of

Carrying 30 feet of 3" Socket Joint Fibre Conduit, weight 36 pounds

transportation and cartage is reduced to a small fraction of that of Clay Conduit.

The following table shows the approximate weight of the various sizes and the average load for a one-team truck:

Inside Diameter	Approximate Weight per foot.	Average load One-team truck.
1 inch	0.50 pounds	8,000 Feet
1½ inches	0.70 pounds	5,700 Feet
2 inches	0.85 pounds	4,700 Feet
2½ inches	1.02 pounds	4,000 Feet
3 inches	1.20 pounds	3,300 Feet
3½ inches	1.40 pounds	2,850 Feet
4 inches	1.60 pounds	2,500 Feet

For handling about the trench, the lightness of this material is an added saving and convenience. On account of the easiness with which it is handled, great speed in laying is attained. A single layer, in installing one 5-foot length, handles six pounds as against forty-five pounds of the average clay. The bed of concrete having been prepared, the laying is very simple and the concrete may be tamped in place around and over it with practically no care and the cheapest labor.

The excavation required for this type of construction is anywhere from ten to twenty per cent less in cross section than that required for the heavier material. This item of the cost of labor should not be overlooked. That common labor can accomplish this is owing to the lightness and long length of Fibre Conduit, which eliminates a large number of joints; to not using a mandrel to secure alignment; to not having to wrap each joint with burlap; to not having to place cement mortar around each joint; and to the Socket Joint connection which insures perfect alignment and a perfectly fitting, waterproof connection.

In a recent installation of 30 ducts in parallel, one man in the trench and two helpers above, laid 6,500 duct feet of Fibre Conduit in four hours.

It is a common occurrence, during the installation of a Fibre Conduit system, for one gang of men, (two layers and three helpers), to average 12,000 duct feet laid every day during the entire construction period. In laying the Socket Joint type of Fibre Conduit, the follow-

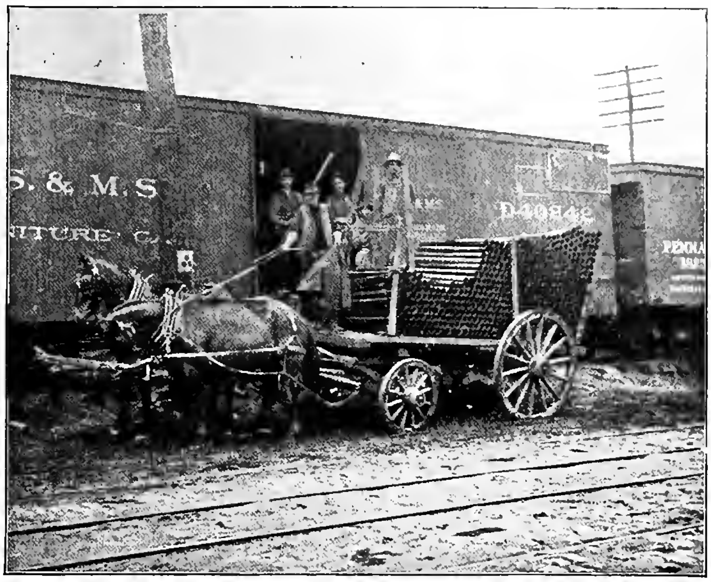
Cross Country Construction—Newark to Jersey City N. J.

Sioux City, Iowa

ing method is customarily pursued. After the trench has been excavated to the required depth, a base or bed of concrete, about 3 in. deep, is placed on the bottom and a line is drawn taut on one side, next to which is laid the first line of duct. The remaining lines of duct are laid parallel to the first line and are separated from each other $\frac{1}{4}$ in. to $\frac{1}{2}$ in. by means of wooden or iron pegs. After the first layer is laid it is covered with concrete and to the depth of $\frac{1}{4}$ to $\frac{1}{2}$ in. The succeeding layers are laid in exactly the same way. When the final layer of ducts has been installed, it is covered with concrete to depth of from 2 in. to 3 in., this final covering being sufficiently heavy to afford protection from possible disturbances caused by future excavations.

Where it becomes necessary to cut a length of the conduit, to break joints or enter a manhole, the remaining part of the length may be utilized by using a sleeve made of Fibre Conduit, having an inside diameter $\frac{1}{2}$ in. greater than the pipe being used for the system. These Sleeves are about 4 in. long and fit over the ends of the abutting conduit, snugly, thus assuring perfect joints and alignment.

New Orleans, Louisiana



3" Socket Joint Type—25,000' Loaded in One Car

An important item to be considered in selecting the material for underground conduit system is the liability of the various conduits to injury from breakage. In a large number of underground conduit installations, the breakage "from factory to destination," "from car to ditch," and "on the street" has amounted to about 10 per cent of the entire shipment and the actual loss represented by such breakage has been close to 7 per cent.

The breakage of Fibre Conduit "from the factory to the bottom of the ditch" averages less than one per cent.

The customary process followed in rodding a conduit system is to push through each and every duct, a series of wooden or metal rods, composed of sections of such length as may be handled inside the manhole and arranged to be easily joined together.. Then, successively, a rope, a mandrel, and a steel brush are attached to the rods and are drawn through each duct.. Owing to this method of procedure, a great deal of time is consumed in rodding.

Users of Fibre Conduit have found that satisfactory results are obtained by utilizing a No. 6, iron wire instead of the rods and the rope. The wire is pushed through each duct from one manhole to the next, then, the mandrels and brush are attached to the end and are drawn through, thus doing away with the rods and rope entirely.

Owing to the smoothness of the interior of Fibre Conduit and the perfect fit at the joints, the wire does not encounter any off-set at the joints nor any concrete that usually is found to have seeped through the joints, when other types of conduit have been used.

On account of the manner in which Fibre Conduit is manufactured, the interior of the duct is finished with a perfectly smooth wall, without burs or blisters of any description, thus giving an absolutely smooth surface for the drawing-in of cables. It is a recognized fact that about 90 per cent. of all underground cable trouble is directly traceable to some injury to the lead-casing of the cable which takes place when the cable is being drawn into the duct; or to lack of protection which should be afforded to the cable after being placed in the conduit. The injuries to the cable while being drawn in are usually caused by burs or blisters on the interior of the conduit, or to nipples of concrete that have seeped through the joints and formed and hardened on the bottom of the duct. In drawing the cable over these defects the sheath becomes seriously abraded or cut. The lack of protection to the cable in the duct is usually from loose and non-water proof joints, which allow stray currents access to the cable.

Injury of any description to the cable sheath is prevented by the use of Fibre Conduit, as the interior or bore is uniformly

smooth and each joint is water-tight. Cables can be drawn through Fibre Conduit with less power than through any other type of conduit and without danger of cutting or abrading the cable-sheath.

This material is extensively used in chemical works and will safely carry vinegar, diluted sulphuric acid and other corroding liquids at fairly high temperatures.

A test on Fibre Conduit at the School of Mines, Columbia College, New York City is reported as follows: "The conduit stood 10,000 volts alternating; when the static voltmeter in the secondary read 10,000 volts, the primary Cardew read 33. The static voltmeter was then disconnected, 10,000 volts being its limit and the voltage was further increased. When the primary read 71 volts, a discharge took place, through the air, around the edge of the pipe, but did not break it down. From these figures, the break-down voltage is higher than 25,000 volts, alternating."

Fibre Conduit has been in use at the power plant of the Telluride Power Company at Provo, Utah, since early in 1904, for carrying 40,000 volt transmission cables.

The St. Paul Gas Light Company, of St. Paul, Minnesota, is using Fibre Conduit for carrying 30,000 volt cables overhead in its power house.

It has been asked to what extent Fibre Conduit is waterproof and the opinion has been expressed that it might in time absorb sufficient moisture to destroy its insulating properties. To ascertain to what extent there is any risk of this occurring, two lengths of conduit were entirely immersed in water for two weeks. At the end of that time these lengths were taken out, one end was plugged up and the interior was filled with water. Some bare copper wire was then wrapped around the outside of the conduit several times, and this was connected to one terminal of a high tension alternating current supply, the other terminal of the supply being connected to the water. The pressure was gradually increased from 500 volts until the insulation broke down. One length of conduit sparked through at 11,000 volts and the other at 13,000 volts. The thickness of the wall of the conduit tested was ¼ inch only. It will be seen, therefore, that the specific insulation resistance of conduit that had been immersed in water for a fortnight was several times that of dry air, and the test appears to prove conclusively that Fibre Conduit is not liable to absorb sufficient moisture to destroy its insulating properties.

Opinions have been made, and at first sight they appear to be sound, that Fibre Conduit, being composed of woodpulp and a bituminous compound, would stand considerable risk of a fire spreading from one end of the duct to the other should an arc be started at any point. Possibly the best reply to this opinion is the result of an experience in a large installation in Brooklyn, N. Y. A heavy short circuit occurred in a 3-inch conduit. The cables were melted into a solid mass of copper and lead of nearly 1-in. cross section. In spite of the intense heat necessary to melt the conductor to this extent, the conduit was hardly damaged. The wall of the conduit directly below the destroyed cables was slightly charred and the arc formed appeared to have burnt away a portion of the top wall of the conduit, and the carbonized remains were clinging to the top surface. The important point is, however, that the fire did not spread. Similar burnouts in clay conduits have destroyed the conduits, as the intense heat has caused these to crack and shatter to pieces.

Fibre Conduit has been extensively used by many of the largest railway and lighting companies in the east. The installation across the Newark Meadows from Newark to Jersey City, is probably one of the best instances. The foundation for this particular distance is not of the best but this Conduit and its surrounding concrete have given perfect satisfaction since it was put in.

For Power House and sub-station wiring, where large cables are used, Fibre Conduit is particularly applicable.

The extent to which it is used may be judged from the fact that the Edison Company of Brooklyn have installed during the past four or five years not less than 800,000 feet per year. During their experience with this material a number of short circuits occurred within the Fibre Duct. In no case was this serious and the Fibre withstood burn-outs, which would have caused tile to go to pieces. A very heavy short circuit lasting as long as twenty to thirty minutes will burn out anything, and in the case of tile is apt to cause the flames to burn through the thin wall and communicate with the cables in the next duct. In the case of Fibre but one cable will be injured, as the Fibre has not only its own wall, but a protection of at least three-quarters of an inch of concrete. In addition to this fact, it has been found that a short circuit in tile duct will invariably cause the duct to fuse with copper and its lead sheathing, creating an obstruction that necessitates usually a street opening to clear and new sections of tile to repair the subway. With a short circuit in Fibre Duct, there is seldom any damage that cannot be remedied with rod and brush. If the short circuit is of sufficient duration to entirely consume the Fibre Duct, the cement casing around the Fibre is uninjured, as, of course, cement concrete is a better fire-resisting material than tile.

On the whole, the advantages in connection with the use of this material are of such importance that they cannot well be overlooked in selecting a material for subway construction. Where high labor costs are of great moment, as on the Pacific Coast, the difference not only in first cost but in cost of finished subway, is even more noticeable than under average Eastern conditions.

ALLIS-CHALMERS INDUCTION MOTORS IN A PAINT MILL.

The ordinary user of electrical power is familiar with the many advantages which are inherent in the induction motor when applied to practically any system of motor drive. But it is only when an application is made of this efficient machine to uses in which it alone is capable of adequately meeting requirements, that the full value of the induction motor is apparent.

Aside from the well known advantages of this type of motor from the point of view of mechanical efficiency, one very important feature is its absolute safety and freedom from fire hazard in places where any other type of power machinery would be more or less of a menace. This quality has recommended the adoption of induction motors for use in paint mills and powder mills where the consideration of safety is paramount.

Not long since the Wadsworth Howland Company of Chicago, paint manufacturers, burned out, and, instead of rebuilding, purchased the paint works of the Geo. W. Pitkin Company, which was being equipped with Allis-Chalmers induction motors of the latest type.

The entire induction motor equipment aggregating 300 horsepower was placed with the Allis-Chalmers Company. The power installation is entirely electrical, including electric lighting, the underwriters allowing no gas or burning of oil in the building.

Thirty horsepower motors will drive six lead mixers, 10 horsepower motors will drive the white lead and putty chasers, three motors being used on tandem mills, 5 horsepower motors will be used on No. 6-A sampling mills and others will be used for driving 20-inch water cooled mills.

The motors were built at the electrical works of the Allis-Chalmers Company in Cincinnati, Ohio.

AMERICAN CONDUIT.

The American Conduit Manufacturing Company, who recently completed their new factory of rigid iron conduit, have found it necessary to enlarge owing to the steadily growing demand for their product. Within the past year "American" conduit has become widely and favorably known on the coast, where it has been installed in some very large buildings. It has the distinction of having been used throughout the first class "A" building completed in San Francisco after the earthquake, namely, Flannery building.

NEWS NOTES

ELECTRIC RAILWAYS.

Boise, Ida.—J. E. Fourtellote & Co. have prepared plans for a one-story car barn for the Interurban Railway Co. It will be 75x150 feet concrete foundation, sand lime brick, sandstone trimming, tar and gravel roof, stone cornice, sheet glass, cement flooring, iron beams, skylights, electric light, etc.

Eugene, Ore.—A. Welch, general manager of the Willamette Valley Co., will make this city his headquarters for several months until the local street railway system and the Eugene-Springfield trolley line, the work on which is about to commence, is completed.

Hillsboro, Ore.—The Oregon Electric Railway Company of Portland has filed for record 35 right-of-way deeds, granting to the company right of way for its line through Garner Home, Tualatin and the eastern portion of Washington county. The deeds provide that the line must be in operation within two years.

North Yakima, Wash.—At a meeting of the stockholders of the Yakima Intervalley Traction Company the report of the engineer in the field was approved and it was decided to at once call for bids for the material to equip the road. The road will be built into the Moxee valley and thence to Zillah, a distance of 24 miles. Another line will be run to Wide Hollow, west of this city.

Olympia, Wash.—The right-of-way plat for a trolley line of the Mineral City Power & Transportation Company, has been filed. The right-of-way extends from Galena to Index along the line of the north fork of the Skykomish river. Rowland & McAllister secured a franchise.

Puyallup, Wash.—Actual construction work has been commenced on the new car line to connect Puyallup, Tacoma and Seattle.

Prosser, Wash.—The Prosser Traction Co., with a capital of $150,000, has been incorporated by Frederick Finn, J. W. Calicotte, G. A. Todd, George E. Boomer and F. A. Jenne.

Snohomish, Wash.—The Snohomish Valley Railway Co. has increased their capital stock to $2,500,000.

Seattle, Wash.—Black Diamond, Enumclaw and Auburn citizens are working to procure an extension of the interurban line of the Puget Sound Electric railway up the Green river to Enumclaw.

Seattle, Wash.—The Seattle, Renton & Southern railway is preparing to install an electric automatic switch at the intersection of Washington street and Fourth avenue south.

ILLUMINATION.

Lakeport, Cal.—At a special meeting the council granted a franchise to the Lake County Electric Power Co. to install an electric lighting and power system within the town limits. G. W. Scott and W. W. Van Arsdale, the millionaire lumber merchants, and Theodore A. Bell, are the principal stockholders of this corporation, which was organized for the purpose of distributing electricity throughout Lake county. The company will receive its electricity from the plant of the Snow Mountain Power and Water Co., which is in course of construction on Eel river. Scott and Van Arsdale, ex-Senator J. N. Felton and others are interested in the Snow mountain project. They will run a high potential line through Lake county. It is the intention of the Lake County Electric Power Co. to have its lighting system installed and electricity turned on by next October.

Fullerton, Cal.—Sealed bids will be received by the city treasurer up to 8 p. m. March 18th at his office in the city hall for the purchase of a gas franchise. Each bid must be accompanied by cash or a certified check for full amount of bid, payable to the city treasurer. The franchise is offered for sale upon the application of George M. Ross of Anaheim, who promises to supply the city with gas within 90 days, if he gets the franchise.

Los Angeles, Cal.—Sealed bids are being received by the board of public works for furnishing and installing ten ornamental cast iron posts on Carr street, between Main and Hill, and the wires, connections, globes and fixtures for said posts, in accordance with plans and specifications on file in the office of the board of public works.

Los Angeles, Cal.—Articles of incorporation will soon be filed for a new gas company with capital of $10,000,000. Following board of directors has been elected: W. E. McVay, W. S. Bartlett, O. T. Johnson, J. F. Sartori, M. S. Hellman, E. T. Stimson, H. W. Frank, W. M. Garland, Randolph Miner, H. Jevne, W. F. Bottsford, J. E. Fishbur, W. D. Woolwine. They will proceed with the construction of an up-to-date gas plant and the work will be rushed to early completion.

Lakeport, Cal.—At a special meeting of the town council the Lake County Electric Power Co. was granted a franchise to install an electric light and power system within the town limits. G. W. Scott and W. Van Arsdale, and Theodore A. Bell, are the principal stockholders in the project.

TRANSMISSION.

Stockton, Cal.—The American River Electric Co. is to erect a large steam electric generator plant in this city in the immediate future as an auxiliary to its water power electricity generating plant on the American river. The report that the Central California Traction Co. was going to erect such a plant in this city is a mistake. The plant will consist of a 3000-horsepower Curtis-Turbine steam engine direct connected to electric generators of the latest pattern. It will cost nearly a quarter of a million dollars and will be kept under steam all the time, but it will be operated only on the failure of the water power plant. It is to guard against lapses in the service that the auxiliary steam plant is to be erected in this city. Col. W. R. Johnson, of the American River Electric Co., says that his company had purchased the south half of block 23, bounded by Madison, Lindsay, Monroe and Fremont streets, and that the above described plant will be erected on that property. He says that the plant will probably be in operation all of the time, as the company had contracted to furnish about all of the electric power that both its water power and steam power plants will generate.

Lemoore, Cal.—At the meeting of the board of trustees recently H. C. Watson appeared before the board and presented a request for a franchise to lay pipes and string electric wires through the corporate limits of the city for the transmission power. Mr. Watson was requested to present his request in writing at the next meeting.

Manton, Cal.—The Northern California Power Co. and the Pacific Power Co., rival claimants to the waters of Battle creek, are each rushing sites five or six miles west of Manton. These two companies have filed upon the same water rights, and the company which succeeds first in appropriating the water will secure title. The Northern California Co. is preparing to put in a dam across Battle creek 150 feet in height, while the Pacific company will put in a dam also two or three miles further up the creek. A large number of men are engaged in preliminary work at both camps, and all available teams in the country are being pressed into service. All the standing lumber at the two Forward mills has been bought up, and lumber is now being cut and hauled green to the scene of operations as fast as possible. The storms and bad roads are greatly hindering the work. Developments are being watched for with a great deal of interest.

INCORPORATIONS.

Phoenix, Ariz.—The California Rapid Transit Railroad Co. has filed its incorporation papers at Phoenix. The capital stock is $10,000,000. The places to and from which the lines of railroads, including the branches, are to run, is described as follows: Commencing at and in the city and county of San Francisco, and running thence through said city and county along such route as may be selected through or near Burlingame, San Mateo, Redwood City, Palo Alto, San Jose, Monterey, and thence to the southerly shore of Monterey bay, thence to Carmel river, a distance, as near as may be, of 140 miles. At some point near San Jose a branch is to commence that will run through Alameda county, via Alameda, Oakland, and Berkeley, thence to Point Richmond, and terminating at Martinez, Contra Costa county, a distance of 75 miles. Commencing at a point near the lines of the main track at Redwood City through Palo Alto, to connect with the line at San Jose, a distance of 22 miles. It is contemplated to build a line from some point between Redwood City and Palo Alto, thence east to the bay of San Francisco, and cross at Dumbarton Point, thence to the city of Niles, the branch mentioned to be 13 miles in length. The total aggregate mileage of the railroad and its branches is 250 miles, as near as may be. The life of the corporation is to be 25 years, and may be prolonged in additional periods of the same length perpetually. The incorporating directors consist of three, appointed to hold until additional directors are elected, as provided for in the by-laws, and are as follows: William G. Alberger, L. E. Lee and William Minto, all of San Francisco. The temporary officers elected are William C. Alberger, president and chief engineer; L. E. Lee, secretary; William Minto, vice-president; W. H. Hart, treasurer. It is certified that $250,000 of the capital stock has been subscribed for by the following persons: W. J. Morgan, H. C. Curting, W. H. H. Hart, A. H. Butler, M. D. Eddy, H. P. Bowie and C. W. Clark, 200 each; L. E. Lee, Wm. C. Alberger and Wm. Minto, 50 each; California Tunnel Co., 950. Total, 2500.

Los Angeles, Cal.—Articles of incorporation of the Home Gas Co. have been filed, with a capital stock of $6,000,000. The object of the corporation is to establish an independent gas plant in Los Angeles. There is a possibility of a movement looking to a consolidation of interests between the above-named company, the People's Gas and Coke Co., and the company now in process of formation by Dr. John R. Haynes and associates. Dr. Haynes has already expressed himself as favoring such a plan. W. Arthur Phipps of Pittsburg heads the Home Company, and Edmund Mitchell is vice-president. Other members of the board of directors are William M. Hiatt, Edward M. Selby, William A. McDonald, John Teefer, E. B. Burton, R. H. Burton and B. O'Neal, all of Los Angeles. Thus far but $900 of the capital stock has been subscribed, but it has ample backing, according to Mr. Phipps' statement.

San Francisco, Cal.—The Mohawk Land and Water Co. has been incorporated with a capital stock of $25,000, by W. J. Woods, J. V. Chase, L. P., E. M. and P. C. Boardman.

Santa Barbara, Cal.—The Carneros Water Co. has been incorporated with a capital stock of $10,000, by J. H. Bishop, Robt. Main, Ida G. and S. P. Stow.

FINANCIAL.

Pomona, Cal.—The board of city trustees at its last meeting took up the matter of the proposed bond issue, the date of election being set for March 14th. G. A. Lathrop of the water company addressed the board advising that the $300,000 bond issue for the purchase of the plant and $25,000 for betterments of the system be submitted separately. He suggested that $10,000 of this be used for the construction of a pipe line from a point north of the Santa Fe railroad to Third street, from which laterals should be run.

San Diego, Cal.—March 12th is the date set for the election to vote on an issue of $885,000 bonds for sewer and water works extensions, grading, fire department and various other improvements to be made by the city.

Oakland, Cal.—With the final details of the transfer of the Contra Costa Water Co. to the People's Water Co. completed, the formal passing over of the old corporation's holding took place last week, and the People's Water Co. is in full control of the water supply of Oakland, Alameda, Berkeley and all the adjacent territory as far as Haywards and Alvarado to the east and south in Richmond in Contra Costa county. The Contra Costa supply developed for Point Richmond and undeveloped as yet for a big territory in Contra Costa county is in the watersheds of San Pablo and Wild Cat creeks. These sources of supply are controlled by the Syndicate Water Co., which passes out of existence and is merged with the new company. The closing of the water companies' deal consummates one of the heaviest financial transactions of the county for years. It involves a stock issue of $20,000,000 and a bond issue of not less than $10,000,000. The report filed by Manager McGary shows that the receipts of the company for the past year were $1,139,139, of which amount $772,746 came from the city of Oakland, or more than 60 per cent. of the company's revenue. During the year the new construction work of the company called for an outlay of $254,021. The operating expenses for the year were $308,279. The aggregate charges for operating expenses, new construction, taxes and interest amount to $947,714, leaving a net revenue of $191,425, if no allowance is made for the $250,000 which has gone into the new construction account and betterments of the plant.

TELEPHONE AND TELEGRAPH.

San Francisco, Cal.—W. R. Hewitt, chief of the department of electricity, filed with the board of supervisors Tuesday an estimate of the cost of construction and equipment of a building and repairs of works under the jurisdiction of the department named. The estimate calls for a total of $590,000. Hewitt asks that the school lot on the north side of Grove street, between Larkin and Polk, be assigned to his department. He figures that it will cost $200,000 for the building, which will include general offices, machine shop, necessary switchboard machinery, motor generators, battery room and underground testing plant. Ten police central stations will cost $25,000 additional. The rehabilitation of the underground system in the burned district, the fire and police boxes and other equipment will require $275,000 more, while the repair of the overhead system will cost $50,000. Hewitt also asks for $40,000 for a stable, including horses and wagons for use of the department. He was the first to respond to the provisions of the resolutions recently passed by the board of supervisors calling on city officials to file an estimate of the cost of rehabilitating their departments.

New York, N. Y.—It has been disclosed that the Mackays, who control the Commercial Cable and Postal Telegraph systems, have become the largest stockholders of the American Telegraph and Telephone Co., which controls almost all of the Bell telephone lines in the United States. This information came through the application made to the Stock Exchange to have listed there the common and preferred stock—about $100,000,000 in all—of the Mackay companies, the holding concern for all the Mackay telegraph and cable lines. The application for listing was granted, and the Mackay shares no longer will be dealt in on the curb. The Mackay holding concern has stock in 102 telegraph and telephone companies, including the Pacific States Co. It also owns Western Union stock, which fact affords a basis for the report that a merger of the two great telegraph companies is not improbable.

Anatone, Wash.—The Farmers Mutual Tel. Co. has been organized by G. E. Campbell, George Zimmerman, W. F. Hurst, Walter Sangster, Perry Barnes and W. C. Halsey.

Bellingham—The Larson Lbr. Co. will build a private telephone line ten miles in length.

Chemawa, Ore.—The farmers of Brooks, Lake Labish, Chemawa and surrounding settlements have decided to incorporate and erect a new telephone line in that section.

La Grande, Ore.—The Home Independent Tel. Co. has been incorporated with a capital of $75,000 by W. H. Behnenkamp, W. J. Church, S. D. Crowe, William Miller and J. L. Caviness.

TRANSPORTATION.

Los Angeles, Cal.—Sealed bids will be received by the board of county supervisors up to 2 p. m. of March 4th for an electric railroad upon certain streets in the county of Los Angeles. Each bid must be accompanied by certified check for the full amount of the bid. Beginning at the intersection of the westerly boundary of Los Angeles with Pico street, running westerly along Pico a distance of 9000 feet.

Los Angeles, Cal.—Sealed bids will be received by the board of supervisors of Los Angeles county until 2 o'clock p. m. of March 4 for a franchise to contract and operate an electric railroad over, along and upon certain public highways, beginning at Third and Vermont on Fourth and Western to Melrose.

City of Mexico, Mex.—Robert C. Brown, managing director of the Mexico Electric Tramways, is here to ask permission from the government for the extension of the street railway system of the Federal district.

San Francisco, Cal.—President George A. Newall of the Presidio and Ferries Railroad Co., told the judiciary committee of the supervisors a few days ago that the Union street line would be ready to run cars on the stretch between Steiner and Polk streets at once, and asked three months' extension to complete the entire road. Chief Engineer Holmes said the western end could and would be constructed within sixty days. The matter will be decided on February 7th.

Los Angeles, Cal.—At the last meeting of the city trustees the Interurban Railway Co. was given a franchise to run a branch line up the alley west of Glendale avenue from Fourth street to Third street, where they will strike another street between G and H streets which they can follow up to Second, thence back to the alley leading to First.

Fullerton, Cal.—Surveyors have been busy at work this week setting stakes from this point southwest to Huntington Beach for the electric railroad.

Huntington Beach, Cal.—A right of way is being surveyed by former County Surveyor S. H. Finley for an electric railroad between Huntington Beach and Santa Ana. It will be built by the Huntington Beach Co.

Merced, Cal.—O. W. Lehmer, superintendent and traffic manager of the Yosemite Valley railroad, with headquarters in this city, states that in his opinion the new line will handle 50,000 people from March 15th of this year to March 15th of next year. He said: "All the grading is completed, with the exception of four miles, and we are confident that we shall have the line ready for operation by March 15th. We believe that we will carry 50,000 people into the valley in the twelve months following. Our road will take the passenger five miles from the Cascades and 12 miles from the Sentinel hotel. There are 1100 men employed on the grades. The road will be built solidly with steel rails, steel bridges and rock ballasted. There are already several mines being opened up along the route and we expect to do a big freight as well as passenger business. One 40-stamp mill is in operation, and two additional mills, one of 40 stamps and one of 100 stamps, are to be installed. The company, furthermore, is planning to construct a wagon bridge at Horseshoe Bend, at the completion of which it will haul all the freight for Coultersville, Big Ock Flat, and as far in as Groveland. It is expected also to carry, during the coming season, the entire tourist travel delivered by both the Southern Pacific and Santa Fe.

San Leandro, Cal.—At a special meeting of the trustees the Oakland Traction Consolidated was granted a franchise to construct a double line to Haywards. In return the company makes concessions as to schedules and fares. The railroad is to run its double tracks to the town limits on the east. It is to bear its portion of expense in repairing the street, and has further agreed to honor San Leandro-Oakland commutation tickets on Sunday. Cars are to be run on a ten-minute headway.

Sacramento, Cal.—J. C. Carly, of the Hawk, Hawley & Carly Co., says that he has signed up an agreement with the Sacramento Gas and Electric Co. for the immediate construction of an extension of the electric road from Highland Park to Curtis Oaks, the new subdivision, through Curtis Oaks to Oak Grove, and thence to the entrance of Oak Park. Mr. Carly says that the arrangement insures a 15-minute service from the Southern Pacific passenger depot.

Colusa, Cal.—Captain W. T. Forsman, who was granted an electric railroad franchise in this county by the supervisors May 2, 1905, started a surveying crew out January 16th in charge of Engineer J. W. Kaerth. This survey is for taking elevations and setting stakes preparatory to the commencing of grading.

WATERWORKS.

San Francisco, Cal.—The Spring Valley Water Co. has perfected plans for a high-pressure water supply for the Western addition. Chief Engineer Herman Schussler has placed an order for 12,000 feet of force pipe to be used in the extension and has decided to place a supplementary pumping plant near Lake Merced.

San Diego, Cal.—The Homeland Improvement Co. will construct a pumping plant at Rose creek at the spot where the city water company contemplated obtaining the San Diego water supply. The water will be piped to a reservoir on the top of the promontory and hillside residences will be supplied with water.

San Diego, Cal.—The South Coast Land Co., which is to supply Oceanside with water, has struck a good supply at the Jones orchard, four miles above Oceanside, on the San Luis Rey river. A 50-horsepower engine and pumping plant will be installed as soon as possible.

San Francisco, Cal.—Engineer Marsdon Manson filed a denial with the supervisors yesterday that he had ever approved of the American-Cosumnes rivers' water supply scheme for the city, as advanced by the Bay Cities Water Co., and cited excerpts from his reports showing adverse criticisms he has made upon the proposal. Among the drawbacks to the proposition Manson alleges that 27 of the 147 square miles of the Cosumnes watershed is privately held, partly inhabited, towns and summer resorts being scattered over it, rendering its water impure.

OIL.

Los Angeles, Cal.—The board of supervisors has ordered the advertisement of franchise for an oil pipe line franchise on Wilshire boulevard.

POWER AND LIGHT PLANTS.

Delta, Ida.—Hill Bros. are planning to build an electric power plant at Carbon Center.

Entiat, Wash.—The electric light plant will be enlarged at once. Mr. Gray, supt.

Missoua, Mont.—The work of installing two additional 150-horsepower boilers to complete the heating and electric power plant of the Missoula Light & Water Company, near the Higgins avenue bridge, has been begun under the direction of G. W. McEwen of Cleveland.

Missoula, Mont.—J. A. Jones, mgr. of the Missoula Gas Co., announced that a site had been purchased for the gas plant and work will be commenced at once. The main building will be of concrete blocks, 38x80 feet ground dimensions. The plant will have a capacity of 120,000 cubic feet per day.

Nelson, B. C.—The West Kootenay Power Co. is installing an addition to its plant which will bring its capacity up to 36,000 h. p.

Pasco, Wash.—W. H. Moser & Co. have secured the contract for building the power station of the Pasco Light & Power Co.

Spokane—A power plant which will be the largest in the west is to be built at Z falls on the Pend d'Oreille river. The water rights and power sites are owned by David T. Ham, Wilbur S. Yearsley and Edgar A. Torrence of this city. 35,000 h. p. will be developed.

Tacoma—It is reported that H. E. Salsich will build a large power plant on the Nisqually river.

Redding, Cal.—The Northern Electric & Power Co. has secured the right to 4000 inches of water taken from the Old Cow creek, South Cow creek, and Hill creek. Two power plants will be built both on the South Cow creek, five miles apart.

CLASSIFIED LIST OF ADVERTISERS

Air Compressors
Henshaw, Bulkley & Co.
Hunt, Mirk & Co.
Platt Iron Works
Rix Comp Air & Mach. Co.

Alternators
Allis-Chalmers Co.
California Electrical Works
National Electrical Co.

Aluminum Electrical Conductors
Pierson Roeding & Co.

Annunciators
Aylsworth Co., H. G.
California Electrical Works.
Century-Klein Electric Co.
Holtzer-Cabot Elec. Co.
Patrick, Carter & Wilkins Co.
Tel. and Elec. Equipment Co.

Asbestos Products
Johns-Manville Co., H. W.

Automatic Sprinklers
Pacific Fire Extinguisher Co.

Batteries, Primary
California Electrical Works
Electric Appliance Co.
Gould Storage Battery Co.
Standard Electrical Works
Tel. and Elec. Equipment Co.
Western Electric Co.

Batteries, Storage
Century-Klein Electric Co.
Gould Storage Battery Co.
Electric Storage Battery Co.

Blue Printing
Dietzgen Co., Eugene

Boilers
Henshaw, Bulkley & Co.
Hunt, Mirk & Co.
Keystone Boiler Works
Moore, C. C. & Co., Inc.
Risdon Iron Works
Standard Electric Works
Tracy Engineering Co.

Boiler Compounds
Dearborn Drug & Chem. Wks.
Johns-Manville Co., H. W.

Buffers
Northern Electrical Mfg. Co.

Chemists and Chemical

Building Material
Johns-Manville Co., H. W.

Building Paper
Johns-Manville Co., H. W.

Circuit Breakers
Cole Co., John R.
Electric Appliance Co.
Fork Wayne Electric Works
Kilbourne & Clark Co.
Century-Klein Electric Co.

Compressed Air
Electric Manufacturing Co.
Pacific Elec. Mfg. Co.

Condensers
O. C. Goeriz & Co.
Rix Comp Air & Mach. Co.
C. H. Wheeler Mfg. Co.

Conduits
American Circular Loom Co.
American Conduit & Mfg. Co.
Aylesworth, H. G.
Cole Co., John R.
Electric Appliance Co.
Century-Klein Electric Co.
Tel. and Elec. Equipment Co.

Conduit Fixtures
American Conduit & Mfg. Co.
Aylesworth, H. G.
Electric Appliance Co.
Century-Klein Electric Co.
Tel. and Elec. Equipment Co.

Cooling Towers
O. C. Goeriz & Co.
C. H. Wheeler Mfg. Co.

Cross Arms
Carter & Co., George E.
Electric Appliance Co.
Century-Klein Electric Co.
Tel. and Elec. Equipment Co.

Draftsmen
Eureka Drafting Room

Drawing Materials
Dietzgen Co., Eugene
Leitz Co., A., The

Dynamos and Motors
Allis-Chalmers Co.
Brooks-Follis Elec. Corp.
California Electrical Works
Century-Klein Electric Co.
Electric Manufacturing Co.
Fort Wayne Electric Works
General Electric Co.
Holtzer-Cabot Elec. Co.
Kilbourne & Clark Co.
Northern Elec. Mfg. Co.
Standard Electrical Works
Tel. and Elec. Equipment Co.
Westinghouse Elec. & Mfg. Co
Wagner Elec. Mfg. Co.

Elevators
Van Emon Engineering Co.

Electric Car Heaters
Johns-Manville Co., H. W.
Northern Electrical Mfg. Co.

Electric Grinders
California Electrical Works
Northern Electrical Mfg. Co.
Tel. and Elec. Equipment Co.

Electric Heating Devices
Johns-Manville Co., H. W.

Electrical Instruments
Cole Co., John R.
Cutter Co., The
Electric Appliance Co.
Century-Klein Electric Co.
Fort Wayne Electric Works
General Electric Co.
Kilbourne & Clark Co.
Stanley-G. I. Elec. Mfg. Co.
Tel. and Elec. Equipment Co.
Westinghouse Elec. & Mfg. Co.
Weston Elec. Instrument Co.

Electrical Machinery
California Electrical Works
Northern Electrical Mfg. Co.
Standard Electrical Works
Century-Klein Electric Co.

Electric Polishers
Northern Electric Mfg. Co.

Electric Railway Appliances
Pierson, Roeding & Co.
Johns-Manville Co., H. W.

Electrical Supplies
Aylesworth Co., H. G.
Bay Shore Elec. Const. Co.
California Electrical Works
Century-Klein Electric Co.
Standard Electrical Works
Tel. and Elec. Equipment Co.

Electric Ventilating Fans
Century-Klein Electric Co.
California Electrical Works
Northern Electrical Mfg. Co.

Engines, Boilers, Heaters, etc.
Allis-Chalmers Co.
Henshaw, Bulkley & Co.

Electric Watchman's Clocks
Pacific Fire Extinguisher Co.
Tel. and Elec. Equipment Co.

Engineers, Chemical
Smith, Emery & Co.
Moore & Co., Chas. C., Inc.
Ohmen Engine Works
Standard Elec. Works
Tracy Engineering Co.
Westinghouse Machine Co.
Hunt, Mirk & Co.

Engines, Gas and Gasoline
Allis-Chalmers Co.
Henshaw, Bulkley & Co.
Moore & Co., Chas. C., Inc.
Westinghouse Machine Co.
Hunt, Mirk & Co.

Engineers and Contractors
Brooks-Follis Elec. Corporat'n
Bay Shore Elec. Const. Co.
Byllesby & Co., H. M.
California Electrical Works
Cannon, Edward F.
Century-Klein Co.
Cole Co., John R.
Copeland, Clem A.
Doble Co., Abner
Cory, C. L.
General Electric Co.
Hunt, Dillman, Meredith & Allen
Hall, Leon M.
Hunt, Mirk & Co.
Jackson, D. C. & W. B
Kilbourne & Clark Co.
Smith, Emery & Co.

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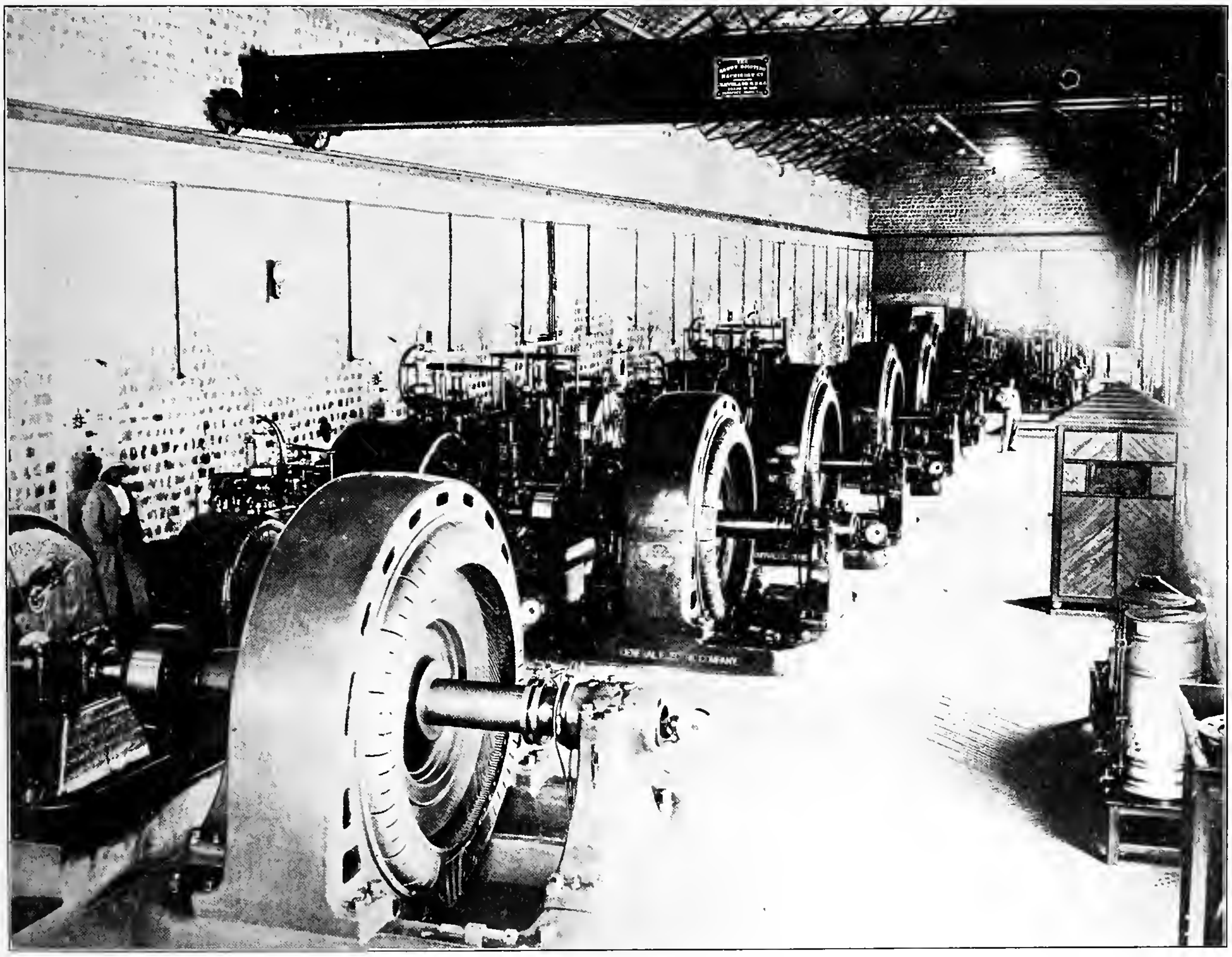
The Great Cauvery Hydro-Electric Development in India

The Cauvery falls are in the province of Mysore, in Southern Asia, not far from the village of Sivasamundram, a Hindu settlement in India, where an abundance of water power is available during the rainy season, approaching a quarter of a million horsepower. There is a fall of about 400 feet, and during the dry season there is about 10,000 horsepower capable of being utilized, by the power plant at present installed and under development.



INTERIOR GENERATING STATION, SIVASAMUDRAM, MYSORE, INDIA.

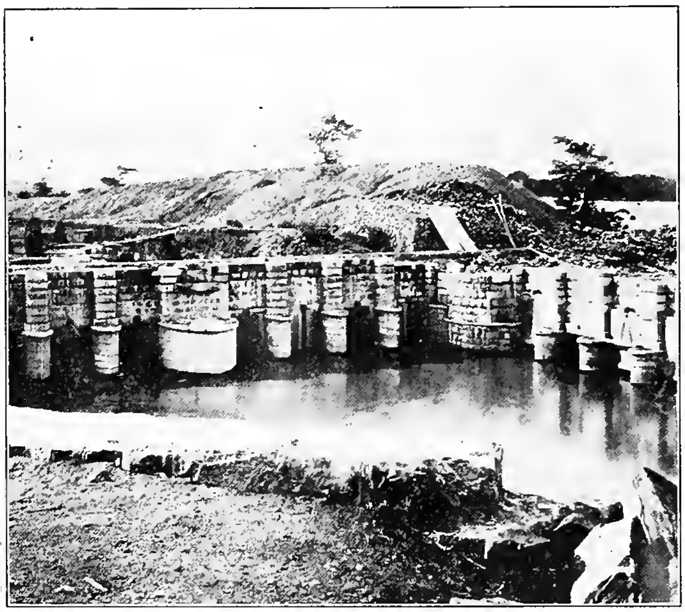
There are two branches of the river which are diverted into the channel intake by two dams, one of which is nearly a third of a mile in length and of V shape construction. The power plant supplies current over a transmission line of nearly 100 miles in length, with a pressure of 35,000 volts, to the Kolar gold fields, where the electric power is utilized for operating the mining machinery.

In addition to this use of the power, provision is made for supplying light and power to the city of Bangalore, which has a population of about 200,000 inhabitants, this transmission line being about two-thirds as long as the one to the Kolar gold fields.

The Cauvery power house noted in the accompanying illustration, which shows the interior with its electrical generators and hydraulic turbines, is located about one mile below the Cauvery falls, while the head gates at the channel entrances are installed nearly the same distance above the falls. There are two channels about three miles long following natural grades or contour of that section, the sides of the two channels being from 10 to 30 feet apart, respectively, at top and base. These channels have trapezoidal sections, the bed width being about 12 feet in rock and 18 feet in earth cutting.

The accompanying illustrations show the construction of the head and scouring sluice, and the eight vent aqueduct of the supply channels. The water is supplied from the intake at the head works through four vents to each channel. These vents each measure about 5 feet by 5 feet in section, the flow in the channels varying from two to three feet per second, according to the gate opening. The scouring sluice vents are about the same sections as the other 5 feet by 4½ feet arranged on the river side of the intake channel.

There are two parts to the forebay, one of which supplies water to the new penstocks and the other to the old ones, the two channels supplying water through the double fore-



HEAD AND SCOURING SLUICE, CAUVERY, INDIA.

bay to eight penstocks in all, the water in the forebay being not over a half dozen feet in depth, with the surplus passing over the waste weir.

The generating station below the bank, the site of which is noted in one of the illustrations, is supplied with water through penstocks nearly 1,000 feet in length, these being of steel construction, each of the five for the last installation supplying water to an impulse water wheel of the Escher-Wyss type of 1250 horsepower capacity.

As noted in the illustration of the power station, each of these horizontal impulse turbines is directly connected to a 750 kilowatt three-phase alternator, built by the General Electric Company, of Schnectady, N. Y., and there are three exciter units of 75 kilowatts capacity, of the same make, each operating at a speed of 465 revolutions per minute. These exciters are over compounded, supplying a current of 110 volts at no load and 115 volts at full load.

It is stated that one of these exciters is capable of exciting the fields of the generators for a load of 5,500 kilowatts at the station with a power factor of 95 per cent., but two exciters are utilized, the third being held as a reserve and for station lighting, the full load of the power house being about 7,000 kilowatts.

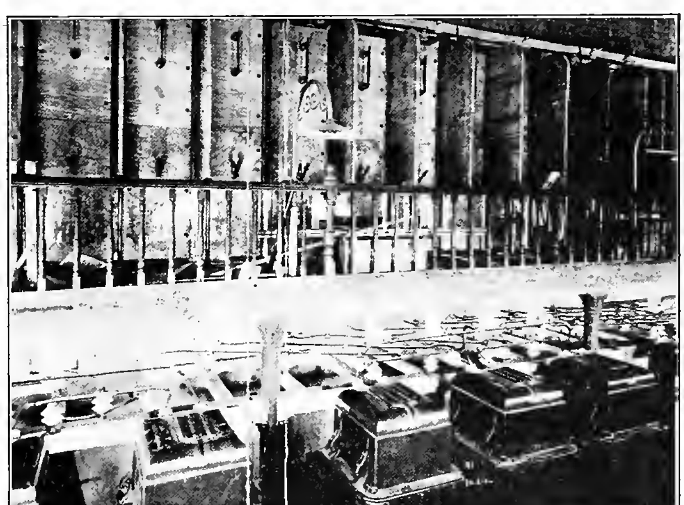
EIGHT VENT AQUEDUCT (SUPPLY CHANNEL) CAUVERY, INDIA.

The main alternators supply a three-phase current of 2,200 volts pressure with a frequency of 25 cycles per second. The horizontal turbines are directly coupled to the alternators, driving the same at a speed of 300 revolutions per minute, these generators being of the revolving field type with Y electrical connections.

It is stated that the efficiency of the turbines is 70 per cent. at half load and 75 per cent. at full load of 1,250 horsepower, this being developed with a head of 382 feet and a flow of 37 cubic feet per minute. The power station is about 260 feet long and between 50 and 60 feet in width, and is built of black trap and granite.

The accompanying illustrations show the transformer house at the head of the bluff completed and in course of construction, and the method of building in India is well indicated by these views, as well as the native dress of the native workmen. The step-up transformer station, an interior as well as an exterior view of which is given, is located about 1,000 feet from the power station and about 400 feet above it on the bluff, and from this building the transmission lines carry the current at 35,000 volts to the various substations, one of which is shown with the conductors entering the step down transformer building.

The current is raised in pressure from that of the generators 2,200 volts to 35,000 volts by means of seven banks of air-cooled, step-up transformers, built by the General Electric Company, at Schenectady, each having a capacity of 350 kilowatts. The power station and transformer house are both

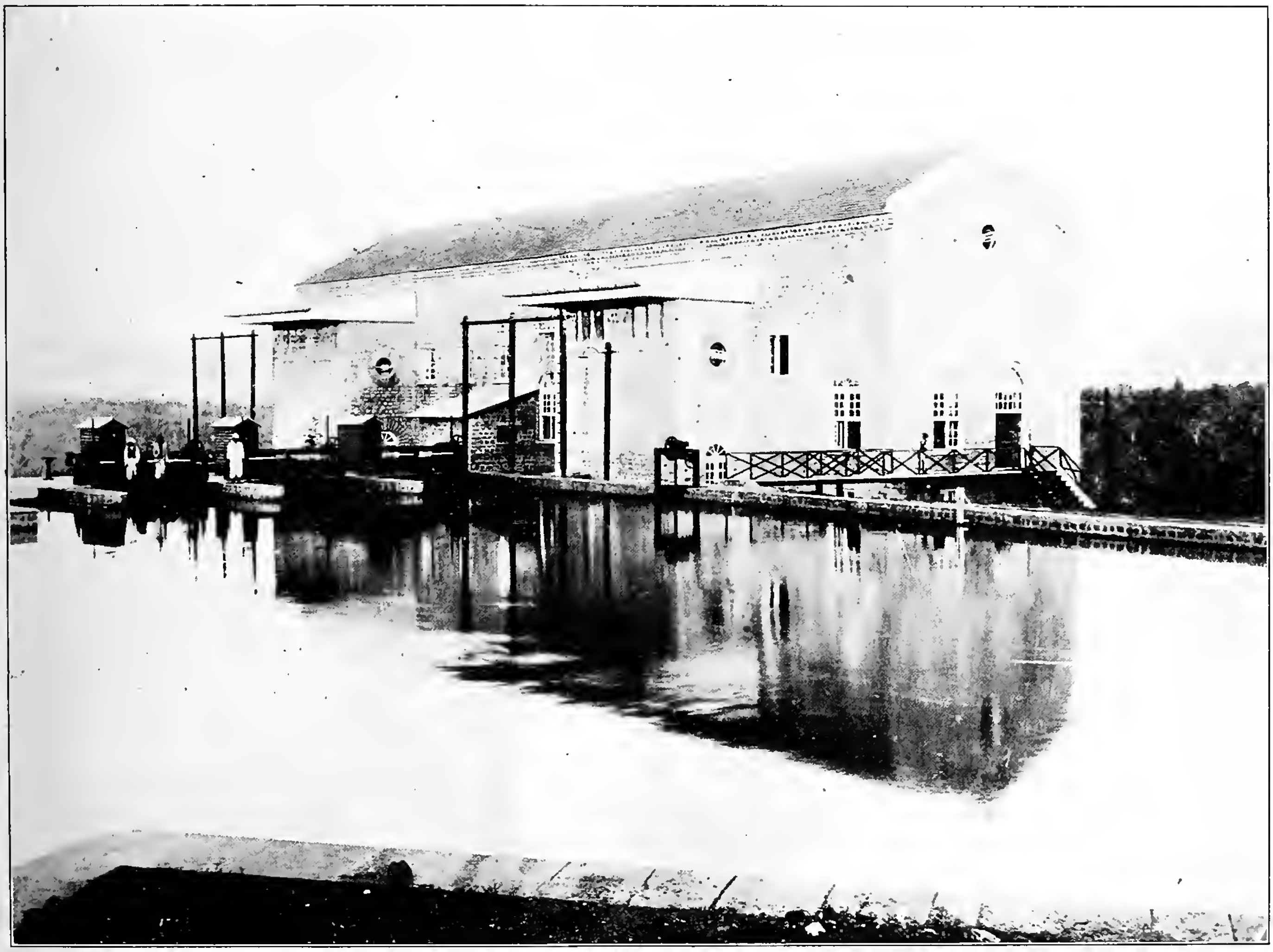


INTERIOR TRANSFORMER HOUSE, CAUVERY, INDIA.

divided into two sections, which may be operated separately or together, as desired. Motor operated oil switches, of the quick acting 2,200 volt type, are used between the two sets of low tension bus bars.

Automatic motor operated double break oil switches of 35,000 volts are used on the high tension lines, one for each transmission circuit, an automatic bellows time limit relay being employed to trip the switches at about 100 per cent. overload. There are two General Electric voltage regulators employed, connected in multiple, one being adjusted for high voltage and the other for low voltage range, controlling the pressure from 115 volts full load to 95 volts no load. The entrance of the high tension wires. This acts as a rain guard, as the monsoon weather is very trying in India, in keeping the insulation perfect. It is stated, however, that more difficulty is found with the low tension Kolar distribution lines than with the high tension circuits, the trouble resulting from the driving rain entering the distribution towers during rainstorms and severe winds being very aggravating.

It is maintained that this hydro-electric power transmission in southern India has given excellent satisfaction, supplying cheap power to the mines, as well as providing all of the comforts which electricity can give, in the way of lighting, heating and power service to the inhabitants of Bangalore.



EXTERIOR STEP-UP TRANSFORMER STATION, SIVASAMUDRAM, MYSORE, INDIA.

regulation takes place automatically with the change of load keeping the voltage constant at the distribution end of the line. The voltage regulator may be operated with one exciter or two or more exciters in parallel, and it is claimed that they are of great value in keeping the transmission line pressure from exceeding a wave voltage in case the station load should all be thrown off, by accident or other cause, acting advantageously with the impulse turbine governors.

It is stated that the voltage is held practically constant at about 30,000 volts at the receiving end of the long distance transmission line at the Kolar gold mines, even though the variation at the power house is from 30,000 volts to 37,000 volts, according to the load, from a maximum to no load. It is held that the line loss is about 15 per cent. at ordinary loads, the potential loss being about 6,000 volts at full load and less than 1,000 volts at no load, the power factor in the former case being 95 per cent. The accompanying illustration of the step down transformer station shows the roof to be extended to an unusual amount on the side near the

ONE HUNDRED YEARS HENCE.

Considerable discussion has been aroused by a signed prophecy of Thomas A. Edison, detailing what our large cities will be like one hundred years hence. He says they will be free from smoke and steam and that the chimney will be a thing of the past, while the waste of coal and other fuel will be stopped through the use of electricity, generated direct from the fuel without the aid of engine, boiler or dynamo. In factories each machine will have its individual motor. Houses will be heated electrically and most of the cities' noises will cease. Skyscrapers will be universal in the business section, and the streets will be bridged over at different heights to facilitate transit from one side to the other. He estimates that buildings will then average thirty stories in height, and the greater number will be constructed of concrete and steel. Such buildings, he says, will stand a thousand years or longer.

RAILWAY GENERATING AND SUB-STATIONS.

By Elbert G. Allen*

The principal feature which characterizes a railway load in its effect upon a generating and distributing system is its fluctuating character. The output to a railway system is never steady. A lightening load varies from hour to hour but its changes are gradual and from time to time the output is steadily increasing or diminishing without material fluctuations.

A single car impresses on the central station a load consisting of a repetition of motor accelerations with a maximum demand during rheostatic acceleration which thereafter diminishes to a minimum of the running current and a period of zero demand during the time the car is coasting, being brought to a standstill, and waiting for loading or unloading of passengers. The average value of such a current cycle is often not more than ten or twelve per cent. of the maximum demand. On interurban service the ratio of average to maximum demand may reach a much larger value.

On suburban line with a number of cars, the maximum current value is not equal to the sum of the individual maxima, as the cars do not start simultaneously. Consequently the ratio of average to maximum demand or the load factor increases with the number of cars on the line. The starting currents appear in the station load, however, as fluctuations super-imposed on a base load which itself varies from hour to hour as the amount of traffic varies. The load factor of an extension system during an hour when the average is uniform, may reach as high as fifty or sixty per cent. The monthly load factor on such a system may be as high as forty per cent. or more.

With interurban systems where the train units are large and few in number, the conditions of load factor are at their worst. Then, while the average load may be small compared to the size of the apparatus, the maximum may tax the station to its utmost.

If the generating system is used solely for railway purposes and good voltage is non-essential, this fluctuating character of the railway load is of little importance, comparatively. Apparatus must of course be of sufficient size to carry the maximum demand without danger and all apparatus must be so designed as to withstand sudden shocks. Synchronous motors driving railway generators must be of such capacity that sudden overloads will not drag them out of step and induction motors should be designed with a rather high "pulling out" point.

When, as is often the case, the generating equipment also supplies a lighting service as well as a railway system, the presence of the fluctuating load becomes more serious by its effect on the regulation. In such cases great care is necessary in the design of the entire system to eliminate the effect of these fluctuations. The prime movers should be controlled by governors, which give a close regulation from no load to full load. It is not, however, customary to compound the generators supplying a mixed service. Fortunately the momentary fluctuations are usually of small percentage value at the generator of a large mixed system. There are, however, ways of keeping the generator voltage steady, irrespective of output. The best of these is probably the Tirrill regulator. This very effective regulator operates on the fields of the exciter by short circuiting the field rheostat. The regulator is under the control of a solenoid supplied from the generator brises. When the voltage drops slightly the regulator operates to short circuit the field rheostat of the exciter, causing the exciter voltage to suddenly rise. This rise causes the regulator contacts to open again, but the rise in exciter voltage has by this time raised the generator voltage to normal. The result is a continuous vibration of the regulator contacts, the relative of time during which they are closed determining the average exciter voltage in accordance with the necessities of the generator to maintain the voltage for which the regulator is set.

Transmission line losses cause railway fluctuations to have a serious influence on the regulation of lighting circuits supplied over the same line. Their effect may often be rendered negligable by the use of Tirrill regulators, operating on synchronous motors or rotary converters. The action in this case is similar to that when the regulators act on the generators. Should the voltage at the substation tend to fall, the regulator causes the exciter voltage to rise, over-exciting the motor, thereby causing a leading current to circulate, which decreases the line drop, bringing up the substation voltage to normal.

An aggravated case of regulation difficulties occurred in a plant where the prime mover, a turbine, was supplied through a long pipe line. The exciter was belt driven from the main wheel. The transmission line was temporarily operated at a comparatively low voltage, giving a line drop of about 15 per cent. at full load. The railway substation was equipped with a synchronous motor generator set, with direct connected exciter. These very undesirable conditions were made necessary by the situation, particularly as regards funds available for the construction of the water power plant.

Poor regulation was anticipated and a Tirrill regulator provided for the substation. Provision was also made for steadying the water pressure by keeping the flow through the pipe line uniform. Without the regulator voltage fluctuations of over 25 per cent. were observed, due to the fact that as load increased and the wheel speed momentarily dropped, the exciter voltages dropped at the very time when they should have been high to compensate for the slow speed of generator and synchronous motor. With the regulator cut in, the fluctuation is less than two per cent.

One might naturally conclude that the best way to prevent fluctuating loads from affecting the regulation of transmission lines and generators would be to cut down the fluctuations. This can be done in a railway system by the use of storage batteries. A storage battery may be placed in parallel with the railway converting machines, and by proper control through a booster may be forced to absorb nearly all the fluctuations. The output of the connecting machinery is then practically constant, varying only with the average output of the station and the generating and transmission system being relieved of fluctuations good regulation is easy to maintain.

Before the perfection of a good voltage regulator a storage battery was often necessary in a substation on the score of regulation. The value of the battery is today more often decided by economic reasons, as the regulation can nearly always be obtained if necessary without the battery.

Rotary converters and motor generator sets are both used in railway substations. For systems with low frequency rotary converters are often preferable on account of their higher efficiency. With a frequency of sixty cycles rotaries become somewhat objectionable on account of their tendency to "hunt," and their liability to flash across between direct-current brushes and fall out of step with any disturbance on the supply circuits. Rotaries also have less range of voltage control through power factor variations on account of their liability to hunt with lagging or leading currents.

Motor generators, despite their poorer efficiency, are often preferable to motor generator sets on account of their greater stability of operation. The fact that motors can be wound for voltage up to about 13,200 often avoids the necessity for static transformers, reducing the cost, increasing the efficiency and simplifying the station lay out.

*This is the third of the series of lectures delivered by Mr. Allen to the class in Electric Railways, University of Washington.

For small substations induction motors are frequently satisfactory for motor generator sets and make the operation much simpler, as no care of synchronizing is necessary. On account of their value in voltage regulating, however, synchronous motors are more often advisable.

Synchronous motor generator sets or rotaries are sometimes very superior to induction sets, as in case of trouble they may be run inverted and alternating circuits supplied from storage batteries for short intervals during repairs, etc.

Electrical apparatus is usually given three ratings, first, the output which it will give continuously without undue heating; second, the overload which it will safely carry for a certain interval, say two hours; and third, the amount of overload which may be carried momentarily without undue strain, commutator trouble or falling out of step. With fluctuating loads the equivalent heating is more than that produced by the equivalent steady average output, as copper losses are proportional to the square of the current. Consequently a railway machine should be rated somewhat higher than the average load which it carries.

Where continuity of service is a necessity, as is almost universally the case in modern practice, there should be in every station a spare machine or spare capacity in the case of overload capacity of machines in service equal to the load carried by the largest unit. For example, a station containing three 500 kilowatt machines, each capable of carrying 50 per cent. overload during rush hours, should not be loaded above 1500 kilowatts at peak, which is a 50 per cent. overload on two machines. For otherwise, if one machine were disabled the two remaining would be loaded beyond their safe capacity.

It should be possible to shut down machine, oil switch, supply line, etc., without impairing the service. Stations should also be so laid out that any switch or section of high voltage bus and wiring can be cut out for repairs. It is not customary to duplicate low voltage switches or feeders, as these can be worked on alive. It is, however, good practice in larger installations to install a spare railway feeder panel on which any feeder may be thrown to facilitate repairs to circuit breakers.

ELECTRICITY AND MOVING-PICTURE MACHINES.

Insurance companies are paying some attention of late to the hazards of moving-picture machines, on account of fires that have occurred from this source. Those devices operated electrically are considered the safest. The arc is maintained by means of carbon pencils as in an ordinary arc lamp. Both direct and alternating currents are used for this purpose. The following suggestions are offered by the underwriters for the installation of the machines operated by electricity:

Appliances.—The knife switch, fuses and resistance coils should be substantially and securely mounted as far from the film-magazine as practicable, so that in the event of an arc occurring at switch-blade contacts, or should the enclosed fuse—which is the only type allowable in connection with this outfit—inadvertently burst through the cartridge and throwing out melted metal, or again, should heat of undue intensity be produced by the regulating coils connected in circuit with the arc lamp, there will be no danger of either the film taking fire or of excessive heat having any effect upon the contents of magazines. The bases of the knife switches should be mounted on slate or marble, and have at least four supporting screws. Measuring on surface of the base, there should be at least one-half inch space between head of screw or washer and nearest contact. The current-carrying wires should be soldered to switch terminals, whether the switch is furnished with lugs or otherwise, as this method gives a safer and more satisfactory contact. The construction details of knife switches are set forth in the National Electrical Code and must be closely followed.

Switches must be so arranged that the opening of the switches will cause all wires attached to them to become disconnected from main service, and furthermore, must be installed in an easily accessible place. Single-pole knife switches used for this purpose will not be tolerated by insurance inspection departments.

Cut-out Blocks must be so designed that it will be impossible to place any fuse of a given class into one which is intended for a current or voltage lower than that of the class to which the fuse is standardized.

Fuses must conform in every respect to the measurements given in the table of dimensions appearing in the National Electrical Code Details of Fittings. If cartridge fuse block is set within a metal enclosure, the surrounding atmosphere must not rise to a greater temperature than 125 degrees Fahrenheit without melting the enclosed fuse. It is well to remember that the rated capacity of fuses so installed must not exceed the attainable carrying capacity of rubber-covered wire.

Resistance Coils, where necessary, should invariably be stationary and isolated from inflammable material. They must be treated as sources of heat, and as such will often require the placing of a suitable heat-resisting material between the device and its surroundings. This may be accomplished when installed within metal box if the coils are rigidly suspended from top of booth at rear, and further protected by securing several plates of tin or sheet-iron around coils with an air space between, taking care that this protection is insulated from the framework, for which purpose the entire resistance box and air plates should be mounted on a slate or marble tablet before being secured to booth. In other words, the attachment of the separating material to its support and to the device must be independent of each other, and this separating material must be continuous between the device and the support; that is, the use of porcelain knobs will not be acceptable. Therefore, the arc-lamp outfit must only be furnished with such regulators as are enclosed in a properly ventilated non-combustible material. As a reminder, it may be well to add that incandescent lamps must not be utilized to this end.

All Wire employed within booth, for whatever purpose, must have an approved slow-burning insulation and secured in place entirely on insulating supports; that is to say, no portable cord will be permitted within booth unless it is pertinent to a proper connection to the lantern itself.

None other than a competent electrician should be allowed to make an attempt to install the equipment above described, as a majority of fires in the past have occurred from approved devices and material being installed by inferior workmen.

There is much prejudice against both magazines and film boxes, the latter employing an open mechanism with sprockets, and reel hangers attached to winding crank, the film passing into a large metal receiving box, for the reason that the film, while being rolled on the take-up reels, will often generate static electricity and cause sparks to ignite film. Hitherto it has been assumed that this frictional disturbance was encountered only in cold weather, but the late experience of several operators has tended to show that some recent fires, which would not formerly have been attributed to static electricity, have been caused by a static spark during the hot season within a poorly ventilated enclosure. To prevent trouble from this source, an electric neutralizer could be installed in connection with the outfit at minimum cost. The device is simple, can be attached to wall outside of booth and wired from there to the inductor-bars, which can be arranged near the film-reel. The principle, well known to electricians, is that of a possible static charge selecting from a pre-arranged neighboring current the small but exact quantity of electricity to neutralize itself.

ELECTRIC CONDUIT FOR STREET RAILROADS.

By C. H. Stut.*

It may be well to state first a few of the differences between the old trolley and the electric conduit systems. First, the conduit does away with the objectionable trolley wire and poles, replacing them by conductor bars placed under ground. This is the main popular advantage of the new system, and constitutes its most potent departure from the old. Also a difference of great importance is the fact that there is no ground return in the underground system, the conductor bar carrying the return current, being insulated identically as is the bar which brings the current from the power house. In this way injurious electrolysis of pipes lying in the path of the return current is completely done away with.

The first requisite for a conduit railway is a continuous tunnel or conduit below the surface of the street. This makes the installation of the railway, in general, an undertaking of great magnitude, for it necessitates the building of the conduit and depressing or removing all pipes crossing its path. But in a city like San Francisco, where many cable roads are already in existence, the conditions are ideal, excepting only the sometimes impossible steepness of the hills, for the cable conduits can, with proper modifications and the addition of new hatches, manholes, electric appliances, etc., be made to serve the purpose of the electric conduits.

According to the plans drawn for the proposed Geary street line, the realization of which was rendered impossible by the earthquake and fire of last April, its construction would have embodied these features as far as the converted cable road could be used. This was possible from Kearney street to Golden Gate Park. The remaining distance is sparsely populated, so that there would have been no serious obstructions in the pathway of the conduits.

The arrangement of the essential parts of a conduit railroad is well shown by the plans for that road. The conductor bars are made of steel, with a T cross section. Each bar is 30 feet long and weighs 7½ pounds to the linear foot. The center of the bar is 15 inches below the top of the slot rail. It is necessary that they be placed low in the old cable conduits, because of the slight slant in their sides. The insulators must necessarily be long in order to give the bars the proper clearance from the sides of the conduit. The insulators support the bars every 8 feet by means of cast steel clips, which are attached to the ends of steel posts, forming the core of the insulator. Where the ends of the bars butt together these clips are made double so as to grip both ends. Although the supporting clips form an electrical bond, no reliance is placed upon them to carry the current. Two copper conductors are used, each equivalent to No. 0000 copper wire, and great care is taken to make a good contact with the steel bars. Each bond terminates in a copper plug, which is seven-eighths inches in outside diameter and exactly fits a corresponding hole. This plug is drilled with a ½-inch hole, into which a tapering steel plug is driven and clinched over, and the whole joint sweated absolutely water tight.

The insulator is one of the most important features of the whole installment, and many difficulties were experienced with different types when electric conduits were first introduced. It must combine great strength with good insulating properties. A satisfactory type is one composed of a cast iron cup bolted with two lugs into the slot rail. The construction necessary on the converted cable conduit is slightly different from this,owing to the different formation of the old slot rails. Rails specially designed for the service have a lower lip to bolt the insulators to and an upper lip to prevent water from dripping down on the bars and insulators. Inside the iron cup is inserted a hollow porcelain cylinder inbeded in cement. The steel core above mentioned screws loosely into the porcelain and is also held by cement. This combination of steel, iron, cement and porcelain gives the required strength.

The current is taken from the conductor bars by means of the plow. This is a device not unlike the cable grip in general appearance. It consists essentially of two shoes and a steel frame, carrying the copper connections from the shoes to the controller in the car above. The copper connections are properly insulated and are of sufficient size to carry the necessary current for the car. The shoes are of cast iron and are held in contact with the rail by flat springs. The San Francisco cable roads had two types of grips, namely, center grips and side grips. With the side grip type the slot is not in the center of the track. When this grip an slot arrangement was used in combination with a turn table terminus, as in the old Geary street road, the slot on both up and down track was nearer the inside rail. This construction necessitates a plow that is suspended in such a way that it can shift from side to side on the truck of the car, so as to accommodate itself to the slot. To effect this side motion of the plow it is hung on bars that run across the truck of the car, and the flexible copper connections allow the necessary lateral play. These plows are not heavy, weighing about 35 or 40 pounds, and can be easily taken up through the plow hatches provided for the purpose. The plow hatches are located at convenient places and are so arranged that the plows can be directly pulled up, the hatch opening as the plow is pulled out. The power house and car barns should be so located that the cars can run in and out by gravity, and also go in or come out from either track. In this way the turn-out need have no conduit, and it is necessary that the plow be lifted before taking the turn-out.

The hatch consists of a cast iron frame, which butts up against the slot rail, and a steel cover reinforced by a web riveted on the bottom. The tops of the rivets should be large, to prevent horses from slipping on the cover.

The conductor bars will be fed with current through feeders every two or three thousand feet, as the service requires. These feed wires will tap from the feeder mains, which run parallel to the track in ducts. These ducts are made of vitrified clay and have remarkably good insulating properties. Ducts made of iron and steel lined with cement have been tried, but the best results are obtained from vitrified clay. The sections are three feet long and the joints are made water tight. The ducts are placed 24 inches below the surface of the street and six feet three inches from the slot center. At every block there is a duct hole, through which a man can inspect or repair the duct and feeders. These duct holes have frames and covers similar to those of the hatches described above.

In order to keep the conduit free from water it is necessary to have numerous sewer connections. At each connection there should be a cleaner hole so that the run way can be kept open. The water should be taken out as fast as it flows into the conduit slot. The troubles that arise from water in connection with the conduit system are due to poor sewer connections rather than to any fault of the system. The amount of rain water that can enter the conduit through the slot is comparatively small and can be easily drained off through proper connections, and only bad sewers will occasion flooding of the conduit.

Street crossings offer the most complications in the conduit system. In crossing a cable road the conductor bar must be cut. The electrical bonds are carried under the cable, which generally runs low enough to clear the plow. If it does not, it must be depressed when the plow is crossing. At making and breaking the circuit on a cross-

*From the "California Journal of Technology."

ing, flashing occurs, and this is an evil which apparently cannot be done away with.

Special yokes are designed to carry the tracks at a crossing. These are similar to the ordinary yokes, but make a 45 degree angle with each track. In this way two larger yokes placed obliquely serve the purpose of four smaller ones. At the crossing of the rails there is heavy pounding of the wheels and to meet the wear consequent to it, removable castings of the hardest steel replace the rails for a few inches.

Where there are switches and the road branches as at a terminus, complications also arise. At such a place conductor bars must be broken and properly placed to prevent interference with the shoe. Special yokes and frames are also designed to carry the branching track and all the regular forms of conductor bars, manholes, etc., must be departed from.

The rails used are nine inches high and weigh 36 1-3 pounds per foot, and the yokes are placed five feet apart.

The conduit is covered on each side by sheet steel, then the concrete is filled in up to the top of the flange of the slot rail.

It is of the utmost importance that the yokes, rails, slot rails, insulators, conductor bars and all their fastenings should be of the very best material and workmanship throughout. The different items that are built in and about the conduit, in combination with the concrete, form the support for the heavy cars and all other heavy traffic that must pass every hour of the day, must of necessity be entirely rigid and unyielding to any such wear and tear and temperature changes that occur year in and year out, for the very life or death of this system depends on this construction. If substantial and good it will subsist, but if it is of inferior material and construction it will soon give way and lead to very costly repairs or reconstruction, which might endanger the system and bring it to financial ruin.

CAR AND LOCOMOTIVE OUTPUT IN 1906.

Official returns from the 38 car-building companies on the North American Continent (estimating two small plants not heard from), give the total number of railroad cars built during 1906 as 243,670. This includes subway and elevated cars, but does not include electric street and interurban cars. In addition to this total, the railroads have built in their own shops a large number of cars, both freight and passenger, but no estimate has been made of these. Of the manufacturers' output, 240,503 cars were for freight service, and 3,167 for passenger service; 236,451 were for domestic use, and 7,219 for export. Canada built 7,059 freight cars and 83 passenger cars, and Mexico built 203 freight and 6 passenger cars. The increase in the Canadian output over last year is 230 per cent. All of the builders have shared alike in the tremendous increase. A number of the companies reported this year the number of unfilled orders on their books. Most of them have more cars on order than they have built during the entire year, with their plants working at their maximum capacity. This is the best indication of the enormous demand for rolling stock and the utter inability of the railroads to get the cars they need.

The following table shows the "Railroad Gazette's" compilation of the number of cars built during the last eight years; totals for 1905 and 1906, including Canada:

Year	Freight	Passenger.	Total.
1899	119,886	1,305	121,191
1900	115,631	1,636	117,267
1901	136,950	2,055	139,005
1902	162,599	1,948	164,547
1903	153,195	2,007	155,202
1904	60,806	2,144	62,950
1905	165,455	2,551	168,006
1906	240,503	3,167	243,670

The locomotive output is quite as phenomenal. The twelve builders in the United States and Canada turned out 6,952 locomotives during the year, of which 6,232 were for domestic use and 720 for export. This is an increase of 27.3 per cent. over last year's total of 5,491. These figures do not include locomotives built in railroad shops, or locomotives rebuilt or repaired. There were built 237 electric locomotives and 292 compounds, as against 140 and 177, respectively, last year. The Canadian output was 217. The following table shows the number of locomotives built during the last 15 years; totals for 1905 and 1906, including Canada:

1892	2,012	1897	1,251	1902	4,070
1893	2,011	1898	1,875	1903	5,152
1894	695	1899	2,473	1904	3,441
1895	1,101	1900	3,153	1905	5,491
1896	1,175	1901	3,384	1906	6,952

The cost of cars and locomotives has increased considerably during the year. Estimating the average cost of freight cars at $1,050, the total spent for freight cars amounts to $252,525,000. For passenger cars at $8,000, the cost was $25,336,000, and for locomotives at $14,500, the cost was $101,384,000. The total amount spent by the railroads for new rolling stock and motive power thus approximates $380,000,000, an increase over last year of about 45 per cent.—Railroad Gazette.

A LIGHT DIFFUSER.

Everyone working at the bench, desk or drafting table likes to have plenty of light, but as the direct glare of sunshine is intolerable, it is generally necessary to screen off the light of windows on the sunny side of the building with shades or ground glass so as to subdue and diffuse the light and thus relieve its intensity. Unfortunately this usually means that a large part of the light is shut out. A scheme which subdues and diffuses the light without greatly reducing its volume was described by Mr. W. J. Thompson at a recent meeting of the Illuminating Engineering Society in New York. He hangs a large sheet of tracing cloth over the windows; the light coming through the tracing cloth is apparently as bright as the direct sunlight, but it is diffused, lighting up a room in very much the same manner as an ordinary skylight. He tried the tracing cloth scheme after trying to get proper illumination in other ways, using screens, awnings, shades, etc., but has found that the tracing cloth shades answer the purpose the best of all. The hint is one well worth consideration in the drawing room and is a scheme easily tried, as the material is always at hand for a trial. It may be that the simple tracing cloth scheme answers the purpose for which expensive prismatic glass arrangements are often insalled; that is, to throw light to the dark side of a room.

TRADE NOTES.

It was announced at the Officers' and Branch Managers' Convention of the Crocker-Wheeler Company, held January 23 to 26, at the main office and works, Ampere, N. J., that the company had done more business during 1906 than any other year since its foundation eighteen years ago. As usual the personnel of the company was almost exactly the same as at the previous annual convention. Among the specialties that have brought phenomenal success to the company during the year, are alternating current generators of large capacity, direct current motors for machine tools and for all other kinds of machinery, the celebrated W type rolling mill motors, transformers and induction motors.

LIGHT.*

By W. R. Whitney.

It is the writer's intention to briefly review the present schemes for the production of light by electrical means and to consider the possible future limitations; to look into present efficiency compared with what we may hope to obtain. In other words, to follow along the lines of thought which the experimenter in this subject naturally follows.

A definition of light might at this point be desirable, but the attempt at best would only result in jumbling a few words together which might satisfy the present knowledge of it, and even then would not give as good a conception of light as we all have. We know it as that agency by which we see. It is a something which affects the retina of the eye possibly somewhat as it affects a photographic plate. In modern times it has been recognized as a form of radiant energy, derived from a source such as the sun, and carried in waves or periodic vibrations through space with a velocity of 190,000 miles per second. In scientific parlance, it is the result of waves of electromagnetic induction in the ether by transverse oscillatory movements of electric charges. But until the luminiferous ether is defined and an electric charge understood, we cannot expect to see it in this way. Accepting this statement, we may simplify it by saying that light is due to energy in space, the energy being in wave form through space. The velocity of propagation of this energy is the same no matter what the size of the wave, so that we may have all wave lengths passing with equal velocity through space and produced by the same general means. The energy will differ only in wave length and frequency. That part of such energy which has wave length varying from 16 to 24-100000 of an inch constitutes light. This is merely because within these limits our eyes are sensitive to the energy. Millions of times greater and smaller waves also exist. The longest ones, such as those of several feet or even much longer, are the ones which, so to speak, are the light to the wireless telegraphic receiver, i. e., they are the wireless waves. The very small ones are only detected by photographic plates, by phosphorescent phenomena, etc.

By causing a motion of electric charges within a circuit of visible dimensions, Hertz, the real father of wireless telegraphy, found that he could produce ether waves with lengths of several feet. It was later shown that they could also be similarly produced with lengths less than an inch. The short waves which give us the sense of light are so small that they could only be produced by the motion of electric charges in ultramicroscopic circuits or in those of the magnitude of atoms or molecules. Thus our methods of producing light are all apparently connected with intromolecular or atomic electrical phenomena.

The radiated energy from the sun is, generally speaking, mostly heat waves, i. e., mostly of longer wave length than the light waves. One might imagine a sun giving off relatively the same light, but much less heat than does our sun. It is this relationship between the heat and the light emitted by any source that determines its light value or light efficiency. A solid body at a temperature of dull redness produces the waves which we call heat without giving much light. The waves are a little too long. As its temperature is raised the light becomes more intense, but more heat is also emitted. As we thus continue raising the temperature, however, the fraction of energy sent off as light increases and the light economy improves. The average wave length is shortening. We would expect that by still further raising the temperature, the body might give neither heat nor light, as it might then emit only such short waves as are beyond our perception except by photography or some other external means. In practice, however, this point is not reached, because the heated body is first destroyed or vaporized. Evidently in attempting to get artificial light we must aim at producing as nearly as possible only the waves of the prescribed length, 16-100000 to 24-100000 of an inch. This has not been done to any great extent as yet; that is, all practical sources of light still send out much more than half the energy as useless heat. In other words, there is plenty of room for improvement in light sources.

To those who are interested, but have not given the point much thought, it may be worth while to show how a knowledge is gained of the actual fraction of applied energy which in any luminous source is obtained as light. One method which seems quite simple, consists in immersing the light in a known quantity of water in a vessel the walls of which may be made transparent or opaque at will. When opaque, the entire energy sent to the lamp ultimately enters the water and raises its temperature at a definite rate. This rate is less when the walls are transparent, by that quantity of energy which escapes as light. The relationship between the loss through the transparent walls and the total input is the "efficiency." An incandescent carbon lamp so tested would show that not over 5 pre cent. of the energy used is emitted in visible form.

The energy of the light which falls upon a black body is all used in heating the body, so that such a body interposed in the path of the light wave after these had been separated from other waves into a spectrum, would form a calorimeter informing us at what rate light energy was being sent to it from the light source. Knowing the total heat value of the light process, for example, the combustion of the oil, we can thus also readily determine its light efficiency. In this way an oil lamp may give about 3 per cent. of the energy of the combustion as light. An electric arc light may be as high as 40 per cent.; consequently there is here a wide margin which permits of oil engines being used to generate mechanical energy, which in turn is transformed by electric generators and used for lighting purposes instead of simply burning the oil in lamps for the same purpose. And this is true in spite of the fact that each such transformation turns a part of the energy into heat.

The various ways of producing light by electrical means may be divided into three classes. Solids heated to incandescence by the passage of the current. Vapors so heated and a combination of both.

The first type is best illustrated by the various kinds of incandescent lamp. The most common are the well known Carbon filament lamp, the Nernst lamp in which a filament of metallic oxides incandesces and the newer vacuum lamps having osmium, tantalum or tungsten filaments.

In this type of lamp it is of the greatest importance to operate it in such a way as to compromise between its practical length of life and its efficiency. This can best be illustrated by a rough experiment which consists in operating an ordinary carbon lamp at very much higher than its rated voltage. Under these conditions its efficiency is very greatly increased but the so-called useful life is less the higher the efficiency. In practice, carbon incandescent lamps are operated at an efficiency of about 3 watts per candle power, and at that efficiency they fall in luminosity to 80 per cent. of their original value within 500 hours. This 80 per cent. point is considered the death of the lamp—that is, the end of its useful life. It might last much longer, but would be continually giving out less and less light. If the same lamp is run at an efficiency one-third greater, in other words, at 2 watts per candle power, its useful life will be only about 50 hours. The efficiency then, that is to be practically preferred is determined by the relationship between the cost of energy and the cost and trouble of installing fresh lamps. This is what has determined the present running rate of the carbon incandescent lamp. The general principles in this case also apply to other filament lamps, so that they are all operated at such voltage as shall make the final cost for the light the least possible.

The mercury arc lamp and such vapor lamps as Geissler or Crookes tubes are representatives of the second class; here there is no consumption of material and the luminosity is due

*From the Sibley Journal of Engineering, Cornell University.

to the incandescent vapors. Another type of incandescent vapor lamp is the magnetic arc lamp in which the vapors of iron or its oxide are heated to incandescence between electrodes, one of which contains the iron or other luminous material which is gradually fed into the arc by the current.

The ordinary carbon arc and the flaming carbon arc are combinations of the two previous types. In the former the light almost entirely emanates from the so-called crater or tip of the positive carbon electrode, the actual arc or path of the current between the electrodes being almost non-luminous. The flaming arcs which are made most familiar to us by the brilliant reddish and powerful lamp occasionally seen on the streets owe most of their lighting power to the vapors of salts, such as calcium fluoride, which are contained in the carbon pencils. A large part of the light in this case also comes from the heated surface of the carbon electrodes.

As there are more incandescent carbon filament lamps made than any other kind, it may be interesting to briefly consider the present process of manufacture. The history of Mr. Edison's experiments, in which all possible sources of filaments or fibres or carbon were tested, are probably well known. In the past carbonized silk, bamboo, paper, cotton and various fibres have been used. The present filaments are usually made from some soluble modification of cotton. The solution is squirted through a die, much as a spider spins a web. The fibre is then hardened by water or alcohol. This is also the common practice in the manufacture of artificial silk. The fibres, made as described, are wound on metal forms to shape them and finally slowly baked until only carbon is left. This is finally heated to a very high temperature in a gas furnace. Such a filament, however, when mounted in an evacuated globe in the usual manner, lasts only about 175 hours at 3 watts per candle. The lamps of today, however, last 500 hours. This considerable difference is due to a coating of graphite which is put upon the carbon filament before it is mounted in the lamp. This coating is an exceedingly delicate process and consists in heating the filament to a very high temperature while in a vapor of benzine or other hydro-carbon. Here the filament not only cannot burn, but it decomposes the benzine vapor and causes carbon as graphite to deposit upon its surface.

In general, the light efficiency of a heated solid increases rapidly with the temperature. For example, an isolated body at a temperature below 500 degrees C. is radiating all its energy in non-visible form. At a dull red heat only a small fraction of 1 per cent. of the applied energy is in the form of light. At about 1000 degrees perhaps 1 per cent. or 2 per cent. is as light. At 2000 degrees it amounts to about 10 per cent.

In all electric lamps, then, the great need is for a substance which shall operate at very high temperature. The temperature which the material will withstand is the limiting feature of all electric lamps, both arc and incandescent. Where carbon is used the temperature is limited by the vaporizing of the carbon. In the case of metal filaments the limit is determined by the melting or softening point of the metal used. It is natural to speculate on the future possibilities of incandescent lamps under these conditions. There is really no reason for supposing that the most stable substance possible has yet been discovered. It is evident that through still higher temperature ranges, the light efficiency will continue to rapidly increase, although it will be later shown that this does not continue indefinitely.

The carbon filament may be run for a few moments at so high a temperature that its light efficiency corresponds to about .4 of a watt per candle power. This is eight times as efficient as its normal operation and possibly corresponds to about 50 per cent. light efficiency. On this basis a hundred per cent. efficiency would correspond to about .2 of a watt per candle. This value includes so many errors that it is not to be looked at as more than a limiting upper value. It also involves the exclusion of what is called selective radiation. In other words, it is based on the so-called black body luminosity.

The carbon lamp at .4 watt per candle is running at a temperature approximating 3500 degrees C. This is above the melting point of any other known substance, although experiments are continually being carried on along the lines of discovering more stable bodies. The carbon filament at ordinary operating efficiencies,—about 3 watts per candle, is at a temperature not far from 1700 degrees C., while the metal filaments, such as osmium and tantalum, probably run between 2000 and 2200 degrees. It is interesting to know that if the carbon filament could be made to withstand for 500 hours the temperature which it bears for a few moments at .4 of a watt per candle, then the cost of operating incandescent lamps would be reduced to nearly 1-10 of the present rate.

In the case of the tungsten lamp this difference is still more marked. This lamp will burn at 1¼ watts per candle for over 500 hours and is, therefore, three times as efficient as the ordinary carbon; but it will also last a few moments at about .2 watts per candle. If it could only be permanent at this point our lighting would be about 5 per cent. of the present cost.

Naturally, the number of elements or compounds which will be stable at temperatures above 3000 degrees is small, but the chemist recognizes that little is known about the chemistry of substances at these temperatures and, therefore, this field must be gone over carefully. Reasoning purely from analogies in nature it would perhaps seem now more normal to experiment with arcs and vapors than with incandescent solids, for astro-physics teaches us that the materials which are withstanding high temperatures are in gaseous state. There seems to be no theoretical difficulty in introducing any desired quantity of electric energy into a given space. Therefore it ought to be possible to finally produce nearly one hundred per cent. light efficiency by a suitable discovery of material.

It is very interesting to note that the work of Sir Norman Lockyer discloses the existence of temperatures in the stellar space which are much higher than that which would probably correspond to 100 per cent. light efficiency—that is in producing light by temperature-rise we may go too far. Light efficiency does not continually rise with temperature and as the average wave length of the radiated energy gets continually shorter with rise of temperature, it may become so short as to be in invisible form. The 100 per cent. illuminant would send all of its energy into the visible spectrum and this is not true of any known illuminant. In all practical cases much energy is radiated in waves too long to be in a visible spectrum; that is, the body sends out infra-red waves. Spectra photographs of many of the stars have shown that most of their energy is in the ultra violet end of the spectrum. Over measurable temperature intervals relationships have been discovered between the total energy radiated and the temperature of the body, and also between the wave length corresponding to the maximum energy in the spectrum and the temperature of the body. As these regularities are practically laws within our known range of temperatures it is natural that attempts to measure the temperature of the stars should have been based upon them. In this way Lockyer has determined the temperatures of the stars ranging all the way from 6000 degrees C. to over 25000 degrees C.

ABOUT RAILWAYS.

In Great Britain you find both the cheapest and most expensive miles of railway ever constructed. The eight-mile line known as the Wotton tramway, and which was built to the order of the late Duke of Buckingham and Chandos, cost only £1,400 a mile. It is of standard gauge and is now used as a light railway.

The most costly piece of railway line in the world is that between the Mansion House and Aldgate, on the Underground, London. It cost nearly £2,000,000. Between Trinity Square and King William statue the record rose to no less than 1,000 guineas a yard, about £30 an inch.—London Answers.

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EDITORIAL.

Engineering and Business as a Profession.

There can be no question that the work of the engineer has been of the greatest importance in the development of the country. Engineering as a profession has become well recognized, and our universities have given a great deal of attention to the organization and development of technical courses to properly train young men to become successful engineers, and it is worth while to consider the real position which the engineer of today occupies in connection with the many enterprises of gigantic magnitude which are being planned and constructed all over the country. It is generally conceded that a man thoroughly trained and experienced is a necessary factor in all engineering enterprises. Nevertheless the reward of the painstaking and successful engineer is small as compared to that of his brother in business. As new processes are developed and thoroughly understood, the demand for the engineer becomes less. If it were not for the continued progress in scientific and engineering matters, it is possible that the details of engineering enterprises would become so thoroughly understood that new appliances and installations would be but duplicates of those preceding.

It is of course true that the engineer is but one factor in our great system of commercial and financial affairs. It is probably also true that many engineers confine their attention too closely to technical details rather than to general principles. It is perhaps but natural that every one who has spent the greater part of his life in significant processes of development, has been personally influenced by this into a particular and rather restricted method of thought. It is but natural also that such persons will have an exaggerated idea of their own importance as compared with the importance of others, whose work is also a part of the general scheme.

After a young man completes the technical courses of a good engineering school, it is quite necessary for him to have his point of view materially modified before he is in a position to fully appreciate the importance of other than purely technical details. It is noticeable that young college graduates, as well as the majority of young workmen, are especially interested in some modification of familiar processes, some shop kink or detail of construction when they have an opportunity to inspect a large manufacturing plant. It is quite evident that they have little concern for such important matters as the source of raw materials, their cost, the character and peculiarities of the manufactured product, its probable destination and use, the successful sale of the apparatus and particularly the system of handling not alone the materials of construction, but also the employees from the highest official to the least important assistant.

As soon as the young engineer, no matter what training he may have had, begins to take an interest in commercial matters, as well as in the technical details, it is remarkable to notice how the broader point of view improves his general ability. He sometimes finds that the technical details in his own mind have shrunken into comparative insignificance and that the commercial side of engineering seems more and more important.

Men of affairs often criticize engineers, saying that as a rule they are too much absorbed in technical matters and neglect almost entirely the administrative and business features which are undoubtedly of the highest importance. It is often remarked that few engineers have thus far become men of affairs, in other words that the supreme power does not rest in their hands. It is undoubtedly true that the feeling exists, principally among financiers, that the training of the engineer necessarily impairs his capacity to become a leader and be responsible for the financial success of large industrial enterprises. It is nevertheless true that within recent years many engineers have risen from modest ranks to the highest administrative positions. These men have not minimized the importance of thoroughly mastering technical details, but they have modified their earlier points of view and taken pains to inform themselves regarding administrative details, the necessity of successfully handling employees and the general management of other details, whether connected with the engineering or business side of the enterprise. With properly directed efforts, the opportunities to reach the highest posi-

tions are very much improved by a thorough professional foundation, but the required technical training must not be allowed to direct the efforts into a restricted channel.

One cannot help being impressed with the fact that the board of directors of every corporation is concerned above all with the necessity of so conducting their business that in the end the balance sheet will be affected most favorably. The engineer has, and ought properly to have, the commercial success of the enterprise always before him. To the engineer are many times left decisions where the supreme consideration is safety and permanence, but he will best serve the great cause of industrial development if he aims to produce good results through good engineering.

The work of the engineer may be divided into two general classes; first, the erection or installation of permanent engineering structures, whether for private or public use; and second, that of producing articles or apparatus for consumption or use. In each the commercial side is of importance, but in the latter or in manufactures the dominating factor in every branch is the cheapening of the cost of production.

In the first class of work a decision on the part of the engineer may and often does materially affect the cost of the installation. The wisdom of such a decision can be pretty thoroughly investigated by the directors of the corporation taking the ultimate end to be attained into consideration. In the latter class of engineering enterprises, however, there are a good many reasons why the business management is of far greater importance than the engineering end, as viewed from the standpoint of the average stockholder or member of the board of directors. The natural fluctuations of the market make it possible for the manager to either save or lose large sums in the purchase of raw material. At the same time the engineering end of the enterprise may be laboriously cutting down the cost of manufacture. Probably in many cases the reduction of the cost of manufacture results in a saving for all time. Very few of those who are responsible for the financial management of such manufacturing concerns recognize that in the end such improvements in the methods of manufacture result in enormous savings, since at the time the reduced cost of construction is much less apparent than a saving due to a fortunate purchase of raw material or an opportune sale of the product of the factory. To the technical man it is most discouraging to have his efforts pass almost unnoticed when he greatly reduces the cost of production, and at the same time witnesses the abundant approval showered upon the manager.

It must be said that there are many brilliant examples of the clear headed men of affairs and the progressive engineer combined in a single individual, and it is this type of man who will more and more come to the front in engineering matters. But to reach this end, the trained engineer must necessarily familiarize himself and keep in touch with current events and developments in the financial world, and he must be and remain a close student of the great economic questions of the day.

Naturally the personality of the individual will always affect his choice of a profession. Seldom, indeed, will the inventor or investigator have the characteristics necessary in a general manager. But the number of men by nature and character of mind capable of being inventors or investigators of importance, are comparatively few, while in the present day the commercial development in this country has been so great as to require a large number of men of more or less ordinary ability who should succeed if they but study carefully existing conditions. The difficult problem of successfully handling labor is of increasing importance every day. It is to such matters that the engineer, who has a desire to work in the commercial side of his profession, should give his best attention.

The conducting of every business, large or small, depends for its success upon the closest study, not alone of the prevailing conditions, but a correct diagnosis of tendencies which may be modified or changed by local influences.

The men in whose hands all the greatest enterprises of today are placed are the men not only of foresight, but they are those who have in addition the ability, courage and imagination to shape affairs with reference to the future. They are men of thought and of action, who are more than financiers or general managers, and it must be said more than mere designing or operating engineers. There is no country in which this ability of the highest type is more liberally rewarded than in our own, nor has there ever been a time in the history of our country when men of this type had greater opportunities. In the commercial and industrial development of the nation, many serious mistakes have been made again and again, to which must be attributed not only the waves of prosperity, but also the periods of depression which surely follow and which have robbed every active man, from the laborer to the man of affairs, of years of his life as measured by his savings. If the future generations can receive the better and broader training which results in combining in a single individual the experienced engineer and the able man of affairs, it is not too much to hope that the future will witness a steady and safe, although less spectacular, progress.

MERCURY ARC RECTIFIER DEMONSTRATION.

The General Electric Company are arranging to give a demonstration of their Mercury Arc Rectifier at the Auto Show at the Coliseum, March 18th, San Francisco.

THE CENTRIFUGAL PUMP.

By E. N. Percy.

There is no duty performed by a reciprocating pump at the present time that cannot be duplicated by a centrifugal pump, with greater commercial efficiency, and equal or less first cost; and with less weight of material, less volume of space occupied, and less floor space. This has not always been so, but it can be so, with correct designs. When it is desired to change the path of a moving object, a new force must be introduced. Whether the object be a railroad train, a projectile, fluid, gas or vapor, the change must be made gradually, the rate of change beginning at zero, rising to a maximum, and falling again to zero. The curved path of this change is treated with the same mathematics, whether it be a railroad, a steam turbine blade, or the vanes of a centrifugal pump; the number and size of said paths being the only difference. In turbines and centrifugal pumps, the path itself may move, introducing the element of relative velocity, as opposed to actual velocity.

Since the losses + output = power received, first will be considered the losses in a pumping plant of this type.

All loss may be summed up under five heads: First, those due to skin friction. At low velocities, with smooth castings, and good design, these losses are not worth considering; but narrow ports, rough castings, and unnecessary velocities may bring this one loss as high as 10 per cent. Second, those due to current friction, or the friction and eddying of one current against another. One current should never run opposite to another beside it, nor should it flow in any direction, except parallel with the adjacent currents, and at the same velocities. An instance of this is the discharge from the runner into the currents whirling in the casing. Third, shock and impact; those due to currents meeting, and wasting their energy on each other, or a current meeting a wall, and wasting its energy in swirls and eddies. Fig. 1 shows some of the losses thus incurred, by poor design. The diagram shows a style of runner largely used, under the mistaken idea that the immense port area of an open runner is unnecessary. The shock of impact of the suction on the inside of the vanes causes a loss that is serious, and the high velocity of the discharge into the whirl space, causes other shock losses. Fourth, water leaks around the runner are the source of quite a serious loss. Fifth, air leaks in the suction pipe, or at a suction stuffing box can cause the efficiency to drop 50 per cent., or even prevent the pump operating. Sixth, mechanical losses, from belts, bearings, couplings, bending of shaft, lack of alignment, lack of balance, runner rubbing on casing, etc.

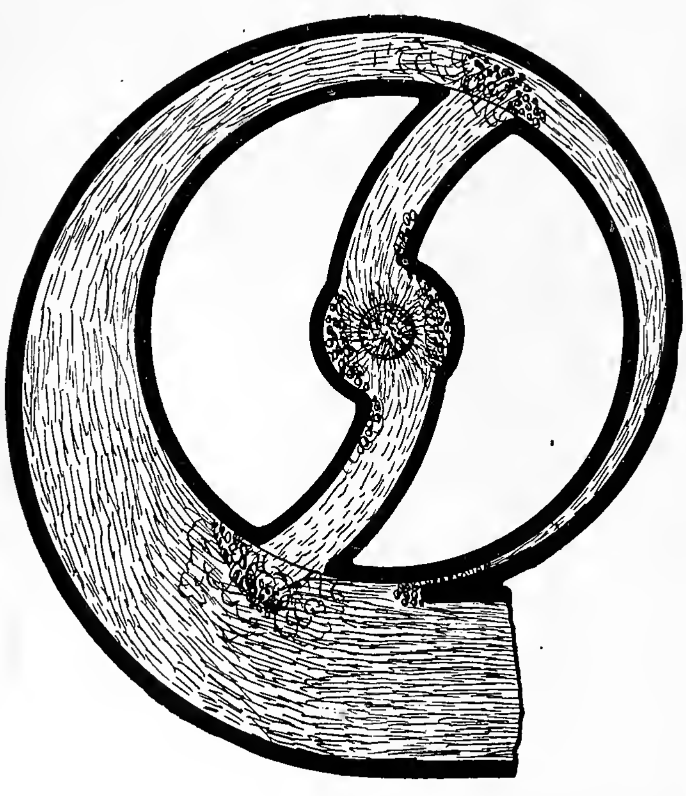


FIG. 1.

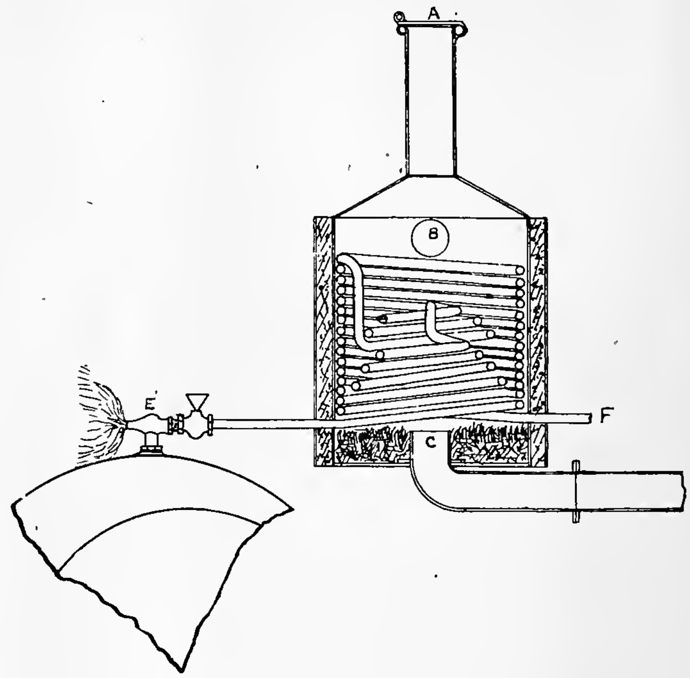


FIG. 2.

Friction is a function of velocity, smoothness of castings and design.

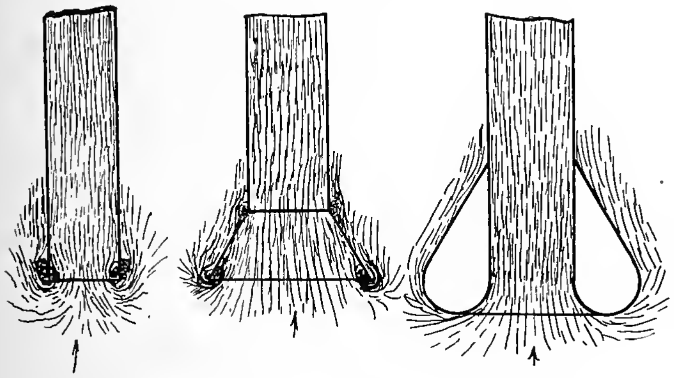
Impact and shock are functions only of change of direction, therefore are controlled by design. All other losses are controlled by the design and workmanship.

Suction pipe losses belong to general hydraulics, but we will make a brief resume with particular reference to the centrifugal pump. As to when the pump can be placed below the water level, and when above it, the engineer must be the judge. The nearer the pump is to the water, or better still, if below the water level, the greater will be the efficiency; this does not demonstrate theoretically; but as air leaks are eliminated, and all of the duty is on the high pressure side of the pump, so many small losses are eliminated, together with the ease of starting, that considerable saving is made. However, if placed below the water level, valves, etc., must be provided to prevent flooding, when cleaning or repairing.

If the pump be placed above the water level, it must be primed in one of three ways, before starting. First, by having a foot valve, and filling the pump with water, either through the discharge pipe or otherwise. Second, by sucking the air out with a steam primer, or air suction pump. Third, by filling the pump with steam, and condensing it with a jet of water, thus drawing up the water for enough to start. All of these methods are satisfactory, but the steam primer is best; the steam primer, of course, is not available where a gas engine or electric motor is used. Fig. 2 shows a steam primer designed by the writer, which can be used anywhere, as it generates its own steam, and costs far less than an air suction pump, and is more rapid. The steam is generated in a continuous coil of ⅝ inch steel pipe, about two hundred feet long, and occupies less than a cubic foot of space. It is enclosed by an asbestos, or fire clay lined casing, and heated by a coal, charcoal, gasoline, or alcohol

fire, as is most convenient; the cost of the most expensive of these fuels, being nominal, to start the pump. No feed pump is necessary, as water from a service pipe, a tank on the roof, or the discharge pipe, will give sufficient pressure to operate the ejector. With an alcohol fire steam can be raised in five minutes and the pump primed in as much more time.

After starting, the apparatus may be disconnected, or it can be heated by the exhaust of a gas engine, entering through C, and exiting by B, first closing the ordinary uptake at A. This is absolutely surplus power; not enough to serve as additional power, but with the ejector, the suction can be improved, or a vacuum can be maintained in the lantern of the stuffing box, thus eliminating air leakage, which in itself is the cause of large efficiency losses.



A B C

FIG. 3.

A suction valve at the bottom will often prevent the emptying of the pump between runs. Also, such a valve is under very little wear and tear with a centrifugal, as it stands open or shut; whereas with a reciprocating pump, it must rise and seat with every stroke. With high speed reciprocating pumps, the current of water is probably near continuous because of its own inertia, but it is certain that the foot valves of these pumps, in practice, show heavier wear. Strainers are hardly necessary, as a centrifugal pump can take any small objects, dirt, or grit, without suffering seriously, and large objects, grass and plants can be kept out with an ordinary grating, or grizzly cage around the pipe. If filtering or straining is necessary, it is better to do it on the discharge side of the pump, as the pump can work more efficiently, in case the strainer or filter is clogged.

In gradually bringing the water in the suction supply from a state of rest to the velocity of entrance, losses from eddying usually occur. These may not be large, but few losses in a pumping plant are large, and by the elimination of some of the small losses we get a large gain and obtain high duty. With an ordinary straight suction pipe, as in Fig. 3-A, the centrifugal force of the streams making the sharp turn around the edge of the pipe causes an eddy, throws the streams out from the edge, and contracts the available entrance area, making a higher entrance velocity necessary at the center. Under a lift of 17 to 20 feet, with a suction pipe designed for a flow of 150 feet per minute, this loss could reduce the efficiency 10 per cent. or more, for it would be impossible for the velocity at the center to increase.

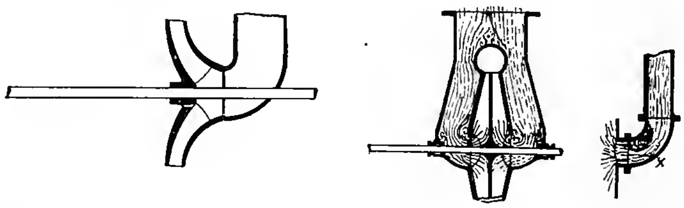
Also, the current coming down the outside of the pipe is opposed to entering currents, and is most affected by the centrifugal force of swinging around the pipe edge, hence it contributes largely to the eddy.

With the bell mouth suction pipe, the eddy losses pertain the same, but the wide bell still leaves ample room for the water to enter, and gradually reach the velocity of flow in pipe, as in Fig. 3-B.

Fig. 3-C shows a suction bell designed by the writer, which eliminates eddies, allows of an easy flow from all directions, without sharp bends, and the water is gradually brought to the full velocity of the flow in suction pipe, and no contraction of area due to eddying takes place.

The pipe should be smooth, free from rivet heads, or other impedimenta, and as straight as possible.

All ells should have as large a radius as possible. Ells at the entrance to pump are very apt to have short radius. The effect is for the inertia of the water to carry it to the opposite side of the ell, see Fig. 4-A, and creating an eddy on the inside of the ell. This contracts the available area of passage, and at point X the water must run with increased velocity.



C. B. A.

FIG. 4.

Fib. 4-B shows the double suction, with losses apt to occur here. First, the incoming stream strikes the rounded part of the pump casing, which could and should be sharpened at this point. Then, the eddies and shock losses under the stuffing boxes. The losses by striking the shaft are insignificant, even in a high duty pump, because the water is flowing nearly parallel to it, as a rule, and because it is small, compared to the stream, and lastly, it cannot be avoided in any reasonable way. At the inside of the stream, where it turns into the pump, is a serious loss, caused by the sharp turn, which allows eddying, contracting of flow area by centrifugal force of sudden turn in stream, and an uneven supply to the runner; less water entering on the under side than on the upper. Fig. 4-C shows a modern high duty suction entrance and runner, which eliminates all of the faults just mentioned, and guides the water easily and continuously through the desired changes of path.

When the suction is on one side only, when the pump is vertical, and in practice, with any pump, the pressures on each side of the runner seldom balance. As a result, some balancing force, thrust rings, or revolving piston must be used to hold the shaft in place lengthwise. This must be considered in placing the suction passages in the design.

A centrifugal pump bearing is a difficult proposition. A high speed, high duty pump must have outside bearings, separate from the stuffing boxes, and of the best possible construction.

Outside bearings would be of babbitt or brass, designed in accordance with approved practice, and lubricates as any high speed bearing. But when the stuffing box and bearing are combined, it is quite a problem to lubricate. A bearing made of lignum vitae wood, stood on end, will receive sufficient lubrication from the water itself, but such a bearing cannot be run very close, and wears badly. A long babbitt bearing, with compressed grease lubrication gives excellent satisfaction, particularly if the grease be pumped in, but this is seldom done. Nothing is more useless than a grease cup here, as the grease is never warm, and the bearing would be kept cool by the water, even though it were being cut to pieces. A jet of water is often used to keep grit away from the bearing.

The coupling up, etc., of the pump, and methods of running, etc., are all matters of ordinary mechanical design.

INDUSTRIAL

WAGNER TRANSFORMERS

The potential transformers manufactured by the Wagner Electric Mfg. Co. have been designed with a high factor of safety. They will carry their loads and maintain their strict ratio without any difficulty.

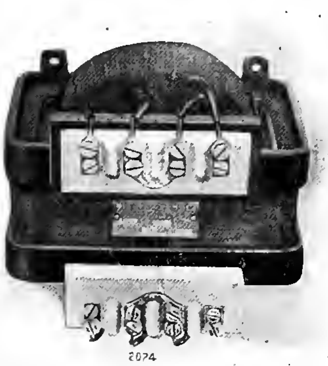
As standard practice, these transformers are manufactured in three different capacities—25, 50 and 100 watt—and are put out both in the dry and oil filled type. As ordinarily recommended, the dry type of transformers are used on voltages up to 2,400, the oil filled type of transformers starting at 2,500 volts and running up to 15,000 volts.

When these transformers were put upon the market, they were first brought out in the 100 watt type only, which in order to meet the demand of central station managers, were made suitable for operation on either 1100 or 2200 primary circuit, with voltage ratio of ten and twenty to one. That is to say, they could be connected by simply changing the terminal block connections as follows: 1100-110 volt circuit, 1100-220, 2200-110 and 2200-220.

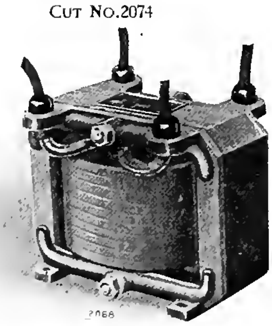
This 100 watt type transformer is suitable for operating one or a combination of instruments. It has capacity, for instance, for the operation of a voltmeter, indicating wattmeter, integrating wattmeter, a power factor indicator, and a synchronism indicator. Some central station managers and switchboard builders have gotten into the habit of running switchboard lights from these potential transformers. This is a habit which we discourage, as a switchboard builder is too liable to overload the transformer if this is done. We therefore do not recommend same.

For smaller boards, boards which do not have the number and complexity of instruments listed above, we make a 50 watt transformer, both with and without interchangeable leads. This transformer has sufficient capacity for operating, for instance, a voltmeter and indicating wattmeter, and an integrating wattmeter.

For smaller installations, we manufacture a potential transformer with 25 watt capacity, suitable for the operation of a voltmeter. In this connection we might state that transformers for the higher voltages, that is above 2,500 volts, are made in the 100 watt capacity only.



Cut No. 2074

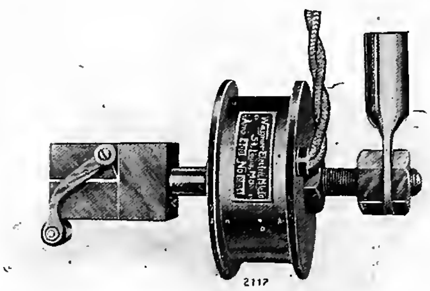


Cut No 2068

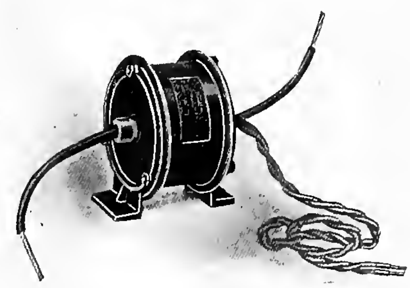
Our cut No. 2074 herewith shows a view of the 100 watt potential transformer, with the terminal boards and connections shown thereon. This is a very compact transformer, suitable for back of board mounting. It is so arranged that it is not easily deranged or put out of order.

Cut No. 2068 shows a 50 watt transformer with non-interchangeable leads, this cut showing a 2200-220 volt transformer.

Series transformers as ordinarily furnished are made in three standard capacities, 2 watt, 10 watt and 30 watt type. We manufacture these with primary capacity from 10 to 10,000 amperes, and suitable for operation on voltages up to 45,000 volts.



Cut No. 2117



Cut No. 1037

The 2 watt type of transformer is manufactured in two different forms, an RA type, shown in cut No. 1037, this cut being the transformer with feet shown with a single primary lead; and an RB type, shown in cut No. 2117, in which you will note the primary of the transformer is formed by the switchstud or the bus bar. This is a very handy form of mounting, as it saves the drilling of holes in the back of the switchboard. This type is manufactured in capacities from 10 amp. to 1000, and is suitable for operation on voltages up to 6,600 volts.

Cut No. 1011

Our type K 30 watt transformer is shown in cut No. 1011, suitable for mounting on back of switchboard. This is built in capacities from 10 to 10,000, and is suitable for operation on voltages up to 15,000. For voltages above 15,000, we furnish an oil type form of construction.

For one ammeter we recommend our type RA or RB 2 watt transformer. For an ammeter with indicating wattmeter or integrating wattmeter, we recommend our type FA 10 watt. For an ammeter, indicating wattmeter, integrating wattmeter and power factor indicator, we recommend our type K, 30 watt.

We do not recommend the use of these series transformers with instruments and the solenoid of oil switches in combination, as we have found that the iron in the solenoid changes the phase relation of the secondary current in the transformer, producing an error in the reading of the wattmeter.

Other types of transformers, both in the potential and series transformer, are built on special orders as needs develop.

PRICE OF ILLUMINATING GAS IN ENGLAND.

Consul F. W. Mahin reports that the price of illuminating gas in Widnes, Lancashire, England, is now 32 cents to small consumers, but will be reduced to 30 cents on July 1st. Large consumers will pay from 22 to 26 cents. This is claimed to be the cheapest gas in the world. The town has about 30,000 population. The price of gas is remarkably low everywhere in Great Britain, whether under public or private control, the general range of price being 40 and 70 cents.—Scientific American.

HASSAM PAVEMENT.

The city of Worcester, about ten years ago, began the laying of granite block pavement on a concrete base, filling the joints and flushing over the surface of the granite blocks with a grout of pea stone and Portland cement. This top coat was only about one-eighth of an inch thick over the surface of the blocks. It was found that for five or six years this pea stone and cement top sustained all the wear without chipping or wearing through. This pavement was very satisfactory, but the cost was large, and in the endeavor to find a pavement which would combine the advantage of this grouted block and yet could be laid at less cost, it occurred to Mr. Hassam, who was at that time street commissioner, that it was an unnecessary expenditure of money to have the stone cut into rectangular blocks and placed one at a time by high priced labor, and he determined to see what could be done by the use of broken stone compacted by rolling.

In April, 1905, he paved a street, laying a depth of six inches of broken stone, pouring the grout of Portland cement over it and then rolling immediately to force the grout through all the voids of the stone. This street was very carefully watched for a year, and it was found to give most excellent satisfaction.

The same method was tried for foundation work under paving during the same year. It was found by this process a denser concrete was formed, requiring less cement and saving an immense amount of labor.

May 1st, 1906, patents for the laying of the above pavement and foundation were granted to Walter E. Hassam and Dr. Charles K. Pevey.

On June 13th, 1906, the Hassam Paving Company was incorporated under the laws of Massachusetts and bought the patents and rights from Walter E. Hassam and Charles K. Pevey.

The following officers were chosen:

President, Walter H. Blodget; vice-presidents, George D. Webb and Charles K. Pevey; secretary, George T. Dewey; treasurer, William D. Lucy; managers, Walter E. Hassam and Claude A. Magill. Offices were opened at 311 Main street, Worcester, Mass., and the company began doing contracting for the Hassam pavement and foundations.

Since that time 115,440 square yards of concrete foundations have been contracted for and 74,723 square yards of the Hassam pavement complete have been laid in twelve cities in the New England states.

Branch offices of the Hassam Paving Company have been opened at 15 William street, New York city, and the Monadnock Building, San Francisco, Cal., and licenses have been granted for laying the Hassam pavement and foundation to the Simpson Bros. Corporation, 166 Devonshire street, Boston, Mass.; the Powell Paving Company, 107 St. James street, Montreal, Canada; the Northeastern Concrete Paving & Construction Co., of Portland, Me.; the Rackliffe-Gibson Construction Company of St. Joseph, Mo.; the Inter-State Paving Co., of Utica, N. Y.

The Hassam pavement, consisting, as it does, entirely of mineral matter, has nothing in its composition to disintegrate by the action of water, oil or acids that may be formed upon the street, and becomes harder for several years after laying. The surface resembles that of a macadam street, excepting that all voids between the stone are completely filled with Portland cement, which binds the stone so firmly that there can be no ravelling or rutting. The cement on the surface wears just a trifle faster than the stone, thus always insuring enough roughness to give a good footing for horses or traction for automobiles. The color of the pavement is dependent upon the color of the stone, varying from the steel blue of the trap rock to the light gray of granite.

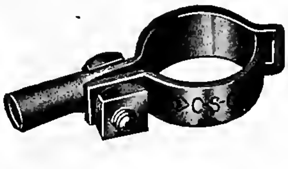
When it becomes necessary to make street openings, the same are easily repaired by the city authorities, it not being necessary to send for any apparatus or plant for mixing or preparing the material to repair the openings. After these openings have been repaired, and travel has been resumed over them, it is only a matter of a few weeks when the joints disappear and the places where the openings were repaired assume the same appearance as the remaining street.

By the use of the Hassam process the cost of concrete foundations for other paving materials can be reduced about 33 per cent. over the cost of ordinary mixed concrete, and in addition a much firmer, denser foundation is obtained; in fact, the Hassam pavement combines the advantages of any known pavement with the possible exception of noiselessness, in regard to which we would say that it is much more noiseless than granite block or brick, and the difference in noise cannot be detected from the asphalt or bitulithic paving, but it is not as noiseless as the creosoted wood block. In addition, the matter of cost is a strong argument for the use of the Hassam pavement, as it can be laid at much less expense than any other known pavement. The only equipment that is needed for laying this pavement is a steam roller, a mixer and a pump, and for a small area the mixing machine and pump can be dispensed with, the work being done by hand. Detailed information and estimates will be gladly furnished by application to the office of the Hassam Paving Company, 311 Main street, Worcester, Mass.

Judging from the remarkable success met with in the past six months, it appears evident that within the next few years it will become the most widely used pavement that there is on the market to-day.

A GROUND CONNECTION CLAMP.

The Chase-Shawmut Company have just put out to the trade a very neat flyer, describing the Shawmut All Copper Ground Connection Clamp which they manufacture.



This clamp, in view of the tendency of central stations to ground their secondary distributing systems, is a device which will prove of great service; it is made in two parts, and when installed, is locked in such a manner as to give the maximum contact upon the device upon which it is installed. The clamp is simple in construction and requires only a pair of plyers to install it quickly and properly.

It is also used to a large extent for grounding the metal sheaths on cable, and for grounding conduit installations. For this latter purpose it is recommended as the simplest and cheapest device on the market.

It is made in sizes from one-half to three inches, and is designed to take a number four wire.

PUMPING ENGINE AT HENDERSON, KY., OPERATES SEVEN YEARS WITHOUT A CENT SPENT FOR REPAIRS.

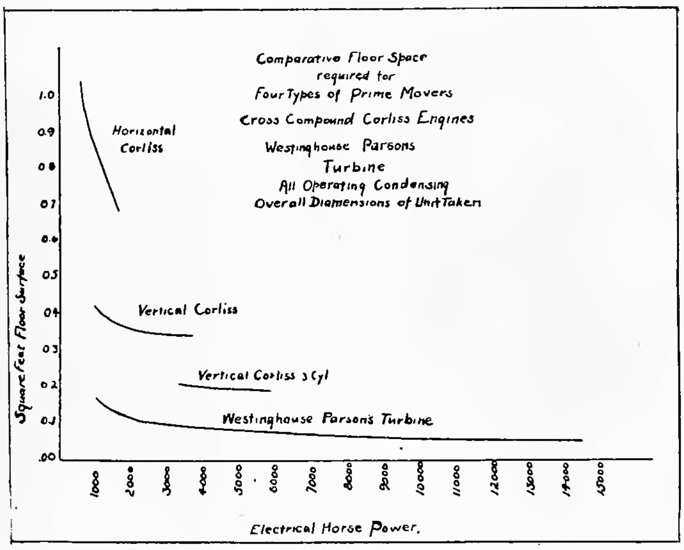
The Henderson Water Works Company, of Henderson, Ky., recently placed a contract with the Allis-Chalmers Company of Milwaukee for a new vertical cross compound pumping engine, having a capacity of six million gallons daily, against a domestic pressure of 172 feet, and a fire service pressure of 260 feet.

This pumping engine is similar in type to one also built by the Allis-Chalmers Company and installed at Henderson in 1899, with a capacity of three million gallons daily. The contract for the new unit was awarded largely on the merit of the older engine, which has made the following record: This engine has been in operation for a period of seven years without costing one cent for repairs, or having been shut down for any but natural causes during that period, in which time it made 64,000,000 revolutions.

10,000 KILOWATT WESTINGHOUSE TURBO UNITS FOR RAPID TRANSIT WORK IN BROOKLYN.

Electric generating units of 10,000 kilowatts capacity, complete in a single machine, have at last become a reality. The introduction of generating machinery of this size has been brought about by the contract recently executed between the Transit Development Co., of Brooklyn, and the Westinghouse Machine Co., of Pittsburg. This transaction is distinctive in carrying not only the largest single order ever placed for power generating machinery, but also units of the largest size contemplated at the present time. The new equipment will consist of five 10,000 kilowatt turbo generator units and a large amount of converting, transforming and controlling apparatus, all manufactured by the Westinghouse interests.

In compactness, the new unit establishes a new standard. Over all, the turbine measures 24½ feet in length, 15 feet in width and 12¼ feet in height, above the floor level. This is equivalent to 3.8 b. horsepower (rated) per square foot occupied, or 5 2-3 b. horsepower maximum; conversely the turbine requires .026 square feet per rated b. horsepower, or .018 square feet per maximum b. horsepower. The combined unit measures approximately 48½ feet in length, equivalent to .075 square feet per kilowatt rated or .049 square feet per kilowatt maximum. That a striking advance has been



made within recent years toward securing greater compactness in prime movers is shown by the accompanying curve, and the end is not yet.

The turbine equipment is designed for a steam pressure of 175 pounds at the throttle, 100 degeees superheat and 28 seconds vacuum. Under these operating conditions assumed, the units are capable of sustaining their full rated load continuously with a temperature rise of 35 degrees C., with power factor ranging from 90 to 100 per cent. In the event of loss of vacuum, accidental or otherwise, the turbines will automatically "go to high pressure" carrying their full rated load without the assistance of a condenser. This feature will be obtained through the use of a secondary admission valve of construction similar to the primary valve and operated by the governor in such a manner as to automatically come into operation when the overload upon the machine reaches a certain point. The action of this valve is to raise the pressures in the various stages and thus increase the capacity of the machine.

Speed variation may be adjusted to a nicety by a distant control mechanism attached to the governor and operated from the switchboard. Close regulation may be obtained if desired when running alone, and when running in parallel with other machines the regulation may be changed to 3 per cent. or 4 per cent. if found desirable.

In the construction of the generator the standard rotating field design will be employed with frame entirely enclosed, so as to facilitate forced ventilation and incidentially obviate the noise emanating from high speed turbines. Current may be delivered at 6,600 or 11,000 volts, according to the method of connecting the windings.

A good feature of the horizontal type turbine is the excellent disposition which may be made of the condensing apparatus. In spite of the compactness of these large units, the surface condenser will be located, as usual, directly beneath in the power house basement, together with all of the condensing auxiliaries, thus giving a clear engine room floor that is not cluttered up by unsightly auxiliaries. This arrangement likewise permits of the most effective means of carrying out the "unit system" in power plant design, which is so important in securing the best arrangement of boiler plant.

It is significant that this new power equipment will be eventually installed in the new Kent avenue station, Brooklyn, where two large turbine units, by the same builders, and a third of another make, but similar design, have been in operation for some time. This station will, then, be distinctively devoted to turbine machinery, the first trying out of which in so important a service furnishes evidence of commercial superiority that may be regarded as conclusive.

WIRING IN CAR SHOPS.

The wiring problem in the car shop involves much the same restrictions in regard to fire risks that are encountered in any modern industrial structure, but after the insurance rules have been complied with there remain several other considerations which must be settled before a satisfactory installation can be made, says the "Street Railway Journal." Where the 600-volt trolley wire is carried into the shop over tracks extending from the car-house proper, special care is needed to prevent the falling of the exposed conductor upon the machinery beneath, because the most disastrous short-circuits may easily occur in case the overhead construction fails. The use of pipe conduit in pit wiring is quite as desirable to prevent mechanical abrasion of circuits as to forestall fires. Convenience of wiring also is worth taking many pains to secure, with respect to the regular and special work of the shop.

Shop-wiring must be inconspicuous and yet quickly accessible, if it is to be of the greatest service. Assuming that the proper sizes of wire have been figured for the different circuits, the problem is to so dispose of the wires that they will not in any way obstruct the movement of machines, materials and employees. Properly installed circuits need very little attention, but when taps are taken off the old lines for new machines it is exceedingly inconvenient and troublesome if the wires are more or less covered by bar iron, brake-shoes, spare coils of motors, shovels, and other articles whose storage rights have not been determined. It ought to be easy to follow the course of every shop power, lighting or heating circuit all through each department where it is carried without climbing up on barrels, tool racks and other impedimenta. Sometimes the concealment of circuits arises from the over-crowding of the shops, but if the wires are run in straight lines, with 90-deg. bends as high up on the walls away from the floor as is feasible in each shop, the chance of interference can be vastly reduced. As far as possible it is better to wire direct-connected motors on individually driven machines by iron conduit rising from the floor than by dropping connections from overhead. The value of the air space above machine tools for crane and hoist work in facilitating the movement of the work is still far from realized in many shops.

NEWS NOTES

ELECTRIC RAILWAYS.

San Francisco—Following the announcement that the United Railroads board of arbitration had agreed upon a 20 per cent. advance in wages for the company's men came news that the Oakland Traction Co. had advanced the pay of its men from 27½ cents an hour to 30 cents an hour for the first year, and an increase of 1 cent an hour each year of continuous employment up to ten years. This, it is claimed, makes the wages of the Oakland carmen higher than in any other city in the world. The effect of this advance has been to make the United Railroads employes dissatisfied with the findings of the arbitration board. While their pay under the new schedule will be practically the same as that of the Oakland men, the union leaders were most anxious to get an eight-hour day, as well as the advanced wage scale. The idea was to get $3 a day for the carmen and then to get an eight-hour day put through the legislature without reference to the wages. There is still a chance that they will succeed, as the board has not made a formal announcement of its decision, and in fact a change may be made, owing to the premature publication of its findings. The present schedule is: Twenty-five cents an hour for the first year, 26¼ cents for the second year, and 27½ cents for the third year and thereafter, and a proportionate increase for all other platform men. Under this scale it makes little difference in respect to the number of hours fixed by legislation, or otherwise, as constituting a full day's work, for the men will be paid by the hour whether the day is long or short.

Redlands—Announcement has been made by Redlands capitalists, who are associated with W. F. Whittier of San Francisco, that Whittier has decided to build the road connecting Redlands with Hemet, which was surveyed several months ago.

Ely, Nev.—A company to be known as the Ely Electric Railroad Co. has petitioned the County Commissioners of White Pine County to grant a franchise for an electric railroad from the new town of Kimberly to the smelter site of the Nevada Consolidated Copper Co. The commissioners will consider the petition at the next meeting. The electric line will be used to haul both ore and passengers. If built, it will be the first electric railway in this portion of the State.

Long Beach—A telegram has been received from United States Senator Flint by Geo. H. Peck, the San Pedro banker, stating that the former had mailed a permit from the War Department giving Peck permission to cross the government reserve with an electric railroad to Point Firmin.

Prosser, Wash.—Council granted a franchise to the Prosser Traction Co. to build an electric line to connect with North Coast railroad on the north and the Columbia river on the south.

Portland—Council amended the ordinance granting a franchise to the Portland and Mount Hood Ry. Co. so as to require the company to build 10 miles of track outside the city within two years.

Portland—The Coos Bay Gas & Electric Co., recently organized by Henry Hewit, of Tacoma, Seymour H. Bell, of Sumpter, and Louis Simpson, of North Bend, will build an electric railroad to connect North Bend, Marshfield and Empire City.

Spokane, Wash.—Council decided to grant a franchise to the Inland Empire Ry. for a subway beneath Front avenue to be completed within two years, to cost $1,000,000.

Outlook, Wash.—The Columbia River, Outlook and Northwestern Railway Co., capital $3,000,000, has been incorporated by W. McF. Stewart and M. C. Stewart, to build a line of railway from Vancouver, Clarke county, to a point at or near the city of Spokane; principal place of business, Outlook, Yakima county.

Seattle, Wash.—The Seattle-Chelan-Spokane Railway Co., with branches at Spokane, Snohomish, and New York City, capital $17,000,000, has been incorporated by Charles M. Meeker and G. L. Stevens, 50 Broadway, N. Y.; Mark F. Mendenhall and John W. Fry, Spokane; P. P. Carroll, Francis M. Carroll, of Seattle; Charles A. Barron, O. M. Cochran, Elliott Colburn, E. Wright, Snohomish; E. E. Congdon, Butte.

ENGINEERING.

Boise, Ida.—Alex. McPherson of Twin Falls states that the Twin Falls Land & Water Co. has decided to commence work at once on the north side canal. It will open to settlers 180,000 acres more land. The company will also build an electric line from the Milner dam to Gooding.

Blackfoot, Ida.—The Lost River Construction Co. has been awarded the contract by the Big Lost River Land & Irrigation Co. for the construction of the necessary irrigation works to reclaim the 80,000 acres of the Carey land in the Lost River Valley.

La Grande, Ore.—The Imbler Ditch Co., capital $5,000, has been incorporated by L. Oldenberg, R. Logan and E. L. Parr.

Medical Lake, Wash.—Eslick Bros. have been awarded the contract for the ditch work on the east shore of Silver Lake which is to carry the water to be used by the Hazelwood Co. in irrigating a large tract of land north of the town. E. A. Oliver has the contract for building a bridge across the north of the lake, a distance of 1000 feet.

Olympia, Wash.—A bill will be introduced into the State Legislature calling for an appropriation of $40,000 to provide for the survey of the unsurveyed lands of the State in connection with the work of the U. S. Geological Survey, and also making provision for the preparation of maps showing the general topography of the country as to the mineral deposits, timber resources, and available water supply.

Salem, Ore.—The State will be asked to appropriate $300,000 contingent on the government supplementing that sum with enough either to buy the existing locks or to build new ones.

Tacoma, Wash.—Mark Maynard has made application to the county commissioners for the right to construct and operate a water works system along certain county roads.

Seattle, Wash.—The Lake Creek Water Co. has incorporated with $500,000 capital by Henry Anderson, R. F. Parkhurst and J. L. Finch.

Walla Walla, Wash.—Senator Ankeny has taken up, with the director of the geological survey, the feasibility of irrigating a 40,000 acre tract of land lying along the Tucanon River in Garfield and Columbia counties.

Washington, D. C.—The government has authorized the following surveys: Chehalis River to Montesano, with a view to the removal of the bar; Cowlitz River up to Castle Rock; Puyallup River, to straighten channel; Skagit River to Sedro-Woolley, Blaine harbor and Bellingham harbor.

TELEPHONES AND TELEGRAPHS.

San Francisco—The Pacific Telephone and Telegraph Co. is about to take control of the Southern Nevada Telephone and Telegraph Co., which circles the mining camps of Southern Nevada. When the Pacific States Tel. & Tel. Co. combined with the Sunset Tel. & Tel. Co. there was a bond issue for the improvement of the company's holdings and for the purchase of new plants. The purchase of the Nevada company is the first of these proposed extensions. At present the Pacific Tel. & Tel. Co. has no communication with the mining districts, but a direct wire will be immediately installed to Goldfield. The Southern Nevada Tel. & Tel. Co. stock is held principally by Malcolm MacDonald, president of the company; Key Pittman, vice-president; W. Y. Williams and D. G. Doubleday, the last named a local mining broker.

Washington, D. C.—Senator Ankeny has been assured that the Senate Committee on Military Affairs will put an item of $190,000 in the military appropriation bill for the extension and improvement of the Alaska telegraph system. It is proposed to put in a second line between Valdez and Fairbanks and to extend the system from Fairbanks to Circle.

Lodi—C. E. Young, with the Sunset Telephone Co., is in Lodi, making arrangements with the local farmers to install a new telephone system. The farmers heretofore have used the barb wire along their fences for their phones, and it will not be long before a new system devised by the Sunset company will be installed in Central California.

Calgary, Alba—Council is planning to install an independent telephone system.

Portland, Ore.—The Home Telephone Co. is laying pipes for underground lines on Grand avenue. The system will be in operation in about thirty days.

Portland, Ore.—The damage to the Pacific States Tel. & Tel. Co. the past week is estimated at $200,000.

Snohomish, Wash.—The Farmers' Independent Tel. Co. have a crew of men at work stringing extra wires.

Skagway, Alaska.—This city and Whitehorse are now connected by telephone.

Leland, Wash.—The Inter Farmers' Tel. Co., capital $10,000, has been incorporated by J. H. Munn and William Bishop.

Pullman, Wash.—The rural telephone line from Pullman to Chambers, Wash., known as the Barbee-Fletcher line, has been sold to a company of farmers, headed by S. H. Breeze, of Pullman. The line will be extended to Johnson, Colton and other towns further south and through the surrounding country.

Moscow, Idaho—Thomas Elson, superintendent of construction of the Pacific States Tel. Co., is here to investigate the local system and make arrangements to install a new and up-to-date exchange.

Roseburg, Ore.—G. P. Mock, of the Pacific States Tel. Co., is here preparatory to installing a new central energy system. A complete cable system is also contemplated.

Victoria, B. C.—The C. P. R. Steamship Co. has decided to equip all its steamers with wireless telegraphic apparatus.

Walla Walla—George Coombs of San Francisco has taken charge of the local office of the Pacific Tel. & Tel. Co., succeeding J. E. McGillivray.

WATERWORKS.

Sacramento—Sealed bids are being received by the city clerk for cast-iron pipe for the extension of the water distributing system in this city. Sixty pieces of 10-inch pipe, each 12 feet long, exclusive of hub; 235 pieces of 12-inch pipe, each 12 feet long. Specifications on file with M. J. Desmond, city clerk.

Berkeley—Work is progressing rapidly on the pumping plant being installed by the People's Water Co. at the wells at San Pablo Creek Basin beyond Stege. Contracts for the machinery have already been let and, according to General Manager Louis Titus, the material will be rushed to the place of operation immediately. Four well-boring gangs have during the past week sunk numerous wells on the premises, and two more will be in operation before the end of the week. "Our plan is to construct the pumping plant as soon as possible," said Mr. Titus. "We also intend to commence the laying of the main pipe into West Berkeley in a few weeks. Machinery is now on its way from the East, to be installed at the pumping station. Millions of gallons of water will be forced through the huge main, four feet in diameter. It is estimated by our engineers that at least $5,000,000 will be expended in this one particular venture, possibly including the pipe line to be run from the San Pablo reservoirs, in the Contra Costa hills, through upper portion of Berkeley."

Modesto—Sealed bids are being received by W. O. Thompson, clerk, for cast pipe and fittings, 3,000 feet of 8-inch pipe, 1,600 feet of 6-inch pipe, 430 feet of 12-inch pipe, two crosses 4x4x6x6, two crosses 8x8x6x6, one cross 8x8x6x12, one cross 12x12x12x6, one tee 12x12x6, one 90-deg. elbow 12x12, one plug 12-inch, three plugs 8 inches, three gates 6-inch, one gate 8-inch.

Susanville—Judge Kelley, of the Superior Court of the County of Lassen, has handed down a decision involving title to the waters of Eagle Lake. For nearly two years the Lassen-Willow Creek Water Co., on the one side, and R. M. Rankin and A. F. Dixon on the other, have been contesting the right to tap Eagle Lake by means of a tunnel, the waters of the lake to be used for irrigating a large tract of arable land in Honey Lake Valley. The court, in its decision, gives judgment in favor of the Lassen-Willow Creek Water Co., a corporation, and enjoins the defendants, or their agents, from interfering with the works of the plaintiff. Now that the rights of the latter company have been adjudicated, the work of tapping Eagle Lake will be resumed with vigor and prosecuted to a finish. The completion of this work means much for Lassen County in particular and Northeastern California in general.

Greenwater—A water supply scheme is now being planned here to furnish not only this camp and its big copper smelter, but also Bullfrog, Johnnie, Rhyolite, Lee and the adjacent camps. The prime movers in the enterprise are Judge L. O. Ray and Governor L. A. Waters, of Scranton, Pa. Associated with them are capitalists who control Eastern investment money. The same men backed a $14,000,000 enterprise to furnish Scranton with water. According to their plans, ditches will convey the water to a big reservoir in the Funeral range, situated at sufficient elevation to give the water the proper fall to the towns to be reached. The company is incorporated for 5,000,000 shares, 2,000,000 in the treasury. Sufficient treasury stock is sold to provide ready capital to push the great work mapped out.

OIL.

Coalinga—The Associated Oil Co. is about to commence drilling a number of wells on section 36, township 20, range 14, recently purchased from McKeveit, Hall and others. This section is considered as gilt edge oil land and looks like the only valuable piece of property thus far acquired by the Associated in the Coalinga field, excepting, of course, the Sauer Dough and "National 30" properties. Work will be resumed on the W. K. Oil Co. well on section 2, township 19, range 15, soon, as the roads are in condition to warrant hauling fuel. Soon as well No. 1 is completed work will be started on well No. 2. It is rumored that the Associated will put down a test well on its property on section 8, township 21, range 15, recently purchased from A. G. Myers.

POWER AND LIGHT PLANTS.

Blaine, Wash.—The plant of the Blaine General Electric Co. shut down for a period of 60 days.

Tacoma, Wash.—Proposals will be received until February 16th for supplying electric current for five years from November 8, 1907.

Waitsburg, Wash.—It is reported that Roberts & Henderson are making arrangements to enlarge the capacity of their light plant.

Los Angeles—Plans for a rival gas company, financed by leading capitalists and bankers of this city, were made public February 5th, by the filing of articles of incorporation of the City Gas Co. of Los Angeles, with a capital stock of $1,000,000, nearly all of which has been subscribed. The directors include J. F. Sartori, J. E. Fishburn, W. E. McVey, R. H. Miner, W. M. Garland, H. W. Frank, and M. J. Connell. The City Gas Co. is intended as a holding of construction company for the Domestic Gas Co., for which articles of incorporation will be filed today. It will have a capital stock of $10,000,000 and will become owner of all the improvements and property acquired by the City Gas Co. The directors of the Domestic company are: O. T. Johnson, W. S. Bartlett, M. S. Hellman, E. T. Stimson, H. Jevne, W. F. Botsford and W. D. Woolwine.

Los Angeles—The Richardo Land and Water Co. has been incorporated with a capital stock of $1,500,000, by Rudolph Hagen, A. Ryon, J. S. Guen and J. V. Ham.

Los Angeles—The Domestic Gas Co. has been incorporated with a capital stock of $10,000,000 by O. T. Johnson, W. S. Bartlett, M. S. Hellman, E. T. Stimson, H. Jevne, W. F. Botsford and W. D. Woolwine.

Los Angeles—The Taylor & Walker Electric Co. has been incorporated with a capital stock of $5,000, by W. F., C. E., Josephine L. and Jessie M. Taylor.

Los Angeles—About 2½ miles from Huntington Beach a small gas plant has been erected at a cost of $65,000 by Los Angeles and Redlands capitalists, where soon will be demonstrated the feasibility of manufacturing fuel gas from peat, from which, when properly treated by a cheap chemical process, a gas for domestic as well as industrial purposes can be had. The company has a large acreage.

Los Angeles—There is possibility of a merger between the new Domestic Gas Co. and the People's Gas and Coke Co. Details of the organization of the Domestic Gas Co. are being worked out by the association of local capitalists, headed by J. F. Sartori and Dr. John R. Haynes. President Sartori of the Domestic company states they are making good progress with their plans for installing a gas plant.

San Francisco—Chas. Dickman is in Nevada at present trying to establish a line of gas plants from Goldfield to Bullfrog. It is reported that the project is well backed by local capital.

INCORPORATIONS.

San Francisco—The California-Nevada Electric Power Co. filed articles of incorporation last week with $10,000,000 capital stock. The company has plans to build and operate plants for manufacturing, transmitting and supplying electric light in California and Nevada. A large number of the power houses will be operated by water power, but where that can not be used provision has been made for the use of other power. The directors are: R. E. Maynard of Los Angeles, F. G. Baum of Berkeley, F. V. Keesling of San Francisco, C. R. Leevers of Reno, and O. K. Grau of this city. The directors have $5,000 of the capital stock.

San Bernardino—The Redlands and Yucaipe Electric Railroad has been incorporated with a capital stock of $1,000,000, by C. S. Chestnut and G. H. Dunn, $800 each; O. D. Collins $200; O. M. Miller and A. A. Moore, $100 each.

FINANCIAL.

Los Angeles—This year only the Los Angeles Gas and Electric Co., the Pacific Light and Power Co., and the Edison Company have made their reports. The People's Gas (Lowe) and the telephone companies have ignored the law altogether. One of the requirements is that the companies shall state the valuation of their holdings. This has been complied with by the companies reporting. The Los Angeles Gas and Electric Co. makes the following report of holdings:

In Los Angeles—	Actual cost.	Present value.
Gas meters	$ 373,352	$ 333,336
Gas services	624,331	567,942
Gas works	1,641,526	1,473,095
Minor imp. (70 per cent.)	21,956	16,864
Office bldg. (70 per cent.)	52,689	50,068
Real estate	270,848	504,360
Regulators	16,983	15,327
Stable (70 per cent.)	4,901	4,302
Street mains	2,334,139	2,172,518
Totals	$5,340,729	$5,137,844
In county of Los Angeles—		
Gas meters	$ 12,736	$ 11,371
Gas services	28,194	25,648
Regulators	121,872	113,427
Totals	$ 169,457	$ 156,452
Grand totals	5,510,137	5,294,297

The Pacific Light and Power Co. and its subsidiary companies reports: Land, $456,306; steam and hydraulic power plants complete, $2,950,786; transmission and distribution systems, $1,874,474; horses, wagons and harness, $10,197; total $5,291,764. Replacements $455,476. Actual cost of properties, $5,747,240.

The Edison Electric Co. furnishes these figures: Real estate and buildings, $386,940; steam plants, $244,260; electric plants, $396,783; shops, $6,298; stables, $8,162; testing appliances, $548,799; water wheel plants, $33,918; hydraulic plants, $548,799; hydro-electric plants, $95,150; transmission and distribution systems and material, $1,561,287; cash value, $3,289,493. Actual cost of above, $3,618,199.

San Francisco—The Potomac Oil Co., under date of January 25th, has declared a dividend of a quarter of a cent a share and makes the announcement that "The management hopes to pay another dividend in May or June of this year, upon the payment of the last installment of the storage oil." Thomas Scott is president of the company.

San Francisco—The financial statement of the Truckee River General Electric Co., for the year 1906, is as follows: Cash on hand Jan. 1, 1906, $6,567.32; gross receipts for year, including California and Nevada, $165,858.10; total, $172,425.42. Total disbursements for the year, $168,527.26; cash balance December 31, 1906, $3,898.16; total, $172,425.42.

San Francisco—Assessor Dodge reports that the total assessment of the Spring Valley Water Co. for 1906 is $6,898,592, of which $1,073,170 is real estate, $611,300 improvements, $3,214,122 personal property, and $2,000,000 franchises.

Los Angeles—The annual report of the Amalgamated Oil Co., submitted February 1st, shows the net earnings to be $442,814.93. The gross gain, including the earnings of the Utah, California Consolidated, the Salt Lake and the Arcturus companies, is $1,786,479.29. Burton E. Green, president, and the old officers and directors were re-elected.

Bakersfield—The Sea Breeze Oil Co. has levied assessment of ¼ of 1c per share, delinquent March 4th, sale day March 21st. L. Hirshfeld, secretary, room 5, Conklin building, 1926 Chester avenue, Bakersfield, Cal.

FINANCIAL.

San Francisco, Cal—The Spring Valley Water Company has filed with the supervisors a statement showing that the cost of its permanent improvements for 1906 were as follows: Real estate and lands in San Francisco, San Mateo, Alameda and Santa Clara counties, $167,290.07; new construction, consisting principally of the labor of laying cast-iron pipe and cost of materials for such work, $501,095.79. The sundry sales of real estate and material amounted to $238,450.03. The operating expenses during year 1906 amounted to $486,775.60, and for the six months ending December 31, 1906, they were $261,917.65. The receipts for the same six months were $786,886.76, and the expenditures $1,431,743.80. The company claims that its records previous to April 18, 1906, were destroyed, and it is unable to give additional data required by the supervisors. The municipal reports for 1902 and 1903 show the following financial operations of the company: Receipts, half-year ending December 31, 1902, $1,010,317; half-year ending June 30, 1903, $1,013,416.67, and December 31, 1903, $1,062,566.42. The expenditures for the same periods, respectively, were $1,088,994, $923,015.46 and $1,166,591.70, of which $374,221.55, $334,839.67 and $373,140.37, respectively, were for permanent improvements. The records of the supervisors for other years were destroyed last April.

Oakland, Cal.—The People's Water Company of Oakland has given a deed of trust to the Mercantile Trust Company covering its entire properties in Alameda and Contra Costa counties, and serving as a mortgage to secure the payment of a $20,000,000 bond issue which the new company's directorate has authorized.

Sacramento, Cal.—Relative to the reported sale of all the property of the Sacramento Gas and Electric Railway Company, a thorough investigation of the system has been made by a corps of expert engineers and explanation offered that this procedure was caused by bondholders who desired to know exact conditions on the system. Since that time careful investigation of all papers, abstracts, titles and claims of and against the company have been closely scrutinized by expert searchers, and a complete abstract of all property of the street-car company is being prepared. This, in connection with the fact that a flattering offer has been made for the property of the Central California Traction Company, gives color to the story that the local street railway is soon to pass into other hands and that an effort to acquire all electric railway properties in this section is being made. It is generally understood that H. E. Huntington is in the field for all electric railway properties that are prosperous in Northern California, and that he will soon be the proprietor of the Sacramento Gas and Electric Railway system. It is rumored that John Martin, the largest holder of stock in the Bay Counties Power Company, is anxious to dispose of his holdings and that the sale of the local street-car system is prompted by his desire to quit the street-car business.

Sacramento, Cal.—It has been unofficially announced that Manager F. E. Fitzpatrick, of the Sacramento Gas, Electric and Railway Company, is soon to become the general manager of all the properties of the Bay Counties Power Co., and that Charles K. McKellip will succeed to his position as superintendent of the Gas, Electric and Railway Company.

Oakland, Cal.—The owners of the Claremont Hotel have contracted for all work on installation of a power plant, boilers, engines, dynamos, etc.

TRANSPORTATION.

Oakland, Cal.—The Key Route company has started the work of constrcuting the new harbor basin on the waterfront south of its present trestle, and the work will, from this time forward, be pushed rapidly. A large dredger arrived on the scene Monday and was stationed at the foot of B street. It will go to work at once dredging out the space lying between the tracks of the Key Route and the Southern Pacific mole. It is thought that in making a channel to the wharves, which will be built along the sides of this basin to a depth of 30 feet, sufficient material will be secured to fill in the 500 acres of land owned by the company along the north side of the basin. The amount of material to be dredged to give the channel a uniform depth of 30 feet will be 5,000,000 cubic yards, and this amount will cover the filled land to a depth requisite for its usage. This filled land will be utilized for sites for railroad terminals and for manufactories. A track will be extended from the wharves which abut on this filled ground to the proposed line of the company on Wood street, which will give the company an outlet in that direction and will give it further connections with such railroad lines which may be seeking the waterfront for terminal facilities. The work of dredging out the channel and the construction of the new wharves, which will give accommodations for fully 200 vessels of the largest size, will be under the supervision of Howard Holmes, the well-known engineer.

Oakland, Cal.—The Southern Pacific Co. has closed the purchase of an entire block lying west of Fruitvale avenue, the consideration being $30,000. The property was purchased by the railroad company as a site for the new power-house and car-barns which the company will erect in connection with the establishment of an electric line to supersede the steam roads which now accommodate the local travel in this city and Alameda. The company proposes to erect one immense power plant at this point for the generation of the electric current for the entire new system. This will require an outlay of half a million dollars.

San Francisco, Cal.—The completion of the entire Union-street line within nine months, of that section of the road between Steiner street and the Presidio within ninety days, and the deposit of a $50,000 bond for the full accomplishment of the foregoing conditions within the given time, were the requirements forced on President George A. Newhall of the Presidio and Ferries Railroad Co. by the Supervisors' judiciary committee. Newhall and his attorney, Lilienthal, objected to the shortness of time more than the requirements for a bond, asking two years for final completion of the electrization of the road. This, however, was denied them, and while not agreeing downright to the giving of a bond, Mr. Newhall made arrangements for Lilienthal to consult with City Attorney Burke concerning its conditions.

Oroville, Cal.—Much progress is being made at Big Bend on the work of erecting the great power plant for the Western Power Company. The thousands of barrels of cement necessary to line the walls of the tunnel will begin to arrive in a few days, and many more men will then be put to work. At the present time there are about 600 men employed.

Santa Rosa, Cal.—The council has passed an ordinance granting to the Pacific Gas & Electric Company the right of using the streets and alleys for the purpose of transmitting, conducting and distributing electric current to be sold and used for heat and power purposes, electric transmission lines and other conductors, appliances and apparatus.

Oakland—Sealed proposals will be received up to February 28th, for the installation of electrical work at the United States Immigration Station on Angel Island. Further information obtained on application to the office of Walter J. Mathews, 969 Broadway, Oakland.

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TRANSMISSION.

San Francisco—F. G. Baum, one of the directors of the California-Nevada Electric Power Company, with offices in the Chronicle building, says: "The California-Nevada Electric Power Co. has been organized to develop power on the eastern slope of the Sierra Nevada Mountains, where it controls no less than 50,000 horsepower, and this can probably be increased to 100,000 if there is a demand for the power. The company has been working on the projects for some time, and had several field parties out last summer getting the engineering information necessary before proceeding with the active construction. It is the intention to supply power to the entire Central Nevada and the eastern side of California."

Stockton—The combination and exchange of power that has been carried on by the Stockton Gas and Electric Co. and the American River Power Co. has ceased to exist, and hereafter the American River Co. will not be given any current in case of a breakdown. This is said to be one of the reasons why there is such a rush to get the auxiliary plant on Mormon channel in operation. The plant was to have been built this year anyway, but the rupture between the two companies made it necessary to get it in working order at the earliest possible date. According to reports the trouble between the two companies was caused by some of the directors of the American River Co. organizing a light company in San Francisco in opposition to the Standard and Bay Counties Power Co.

Watsonville—Owing to the difficulty experienced in securing manufactured stock, the Pajaro Valley Mercantile Co. has decided to engage in the business of manufacturing chandeliers, etc., and has purchased the electrical business of Mudgett & Grant on Third street.

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The Alameda Municipal Light Plant

The city of Alameda, on account of its superior climate and its nearness to San Francisco, with which it is connected by two local train and ferry lines, is primarily the dwelling place of thousands of people whose occupations take them daily to the latter city. Alameda is noted for its many beautiful homes and gardens and as a convenient summer resort for San Francisco people who desire to spend their summer evenings and holidays in the atmosphere of the country. The population is about 20,000.

VIEW SHOWING TYPICAL STREET LAMP ON PARK STREET, ALAMEDA

About eighteen years ago a small electric plant of about 50 kilowatts capacity was purchased by the City Trustees from its private owners. Since then this has developed into the present municipal plant which supplies all the electrical energy needed by the city for public and private lighting and for power purposes.

The plant was not a paying investment until within a few years ago, when it was reorganized on a strictly business basis. Politics was eliminated as the controlling factor

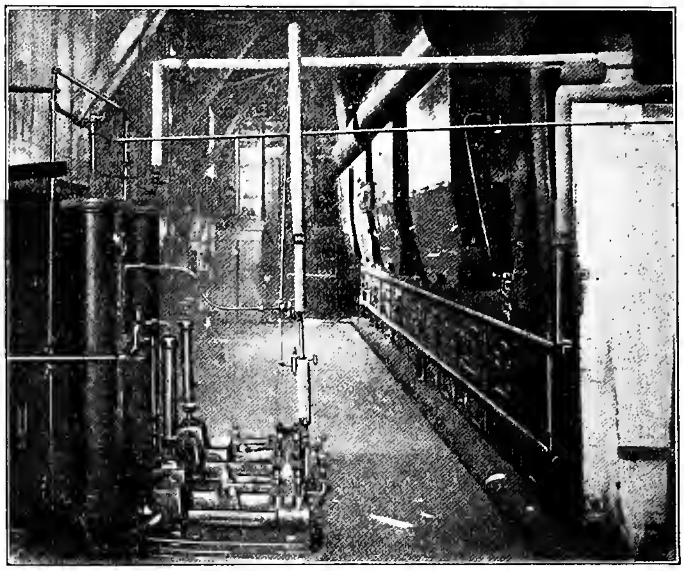
in the selection of employees. The maintenance of plant and outside equipment after the manner of private power plants has resulted in substantial profits, out of which new apparatus has been purchased to meet the increasing demand for power from private consumers.

From July 1, 1905, to June 30, 1906, the electrical output in kilowatt-hours was 941,680 for commercial lighting and power and 202,405 for municipal lighting, making a total output of 1,144,085 kilowatt-hours.

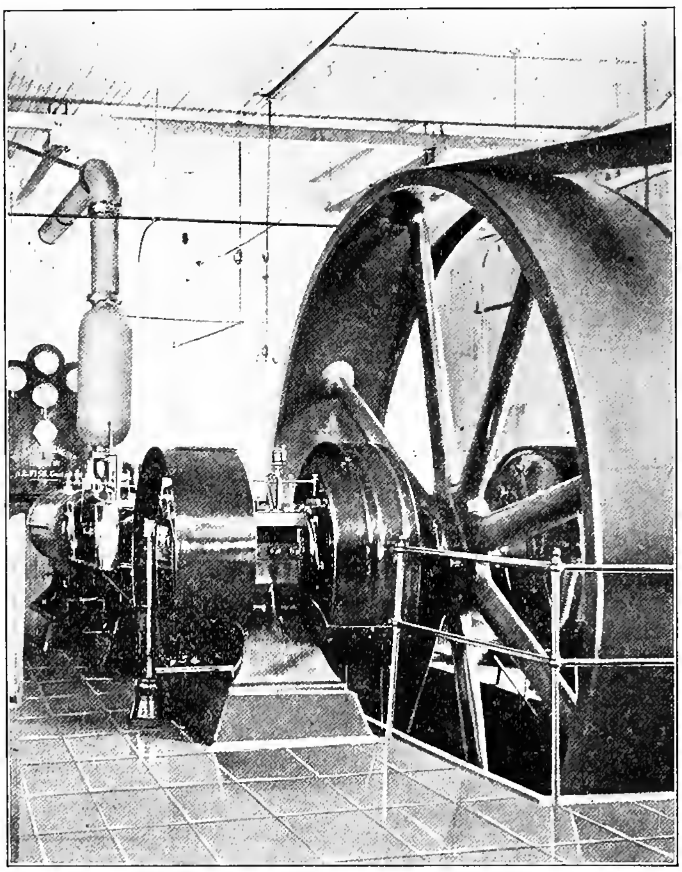
The earnings from the sale of electric power for the same period were as follows:

City lighting	$20,594.45
Commercial lighting	29,504.30
Commercial power	2,417.20
Total	$52,515.95

The total cost of operation, including interest on bonds and depreciation, amounted to $36,455.11. The earnings from private consumers increased 43.5 per cent. over the earnings of the preceding year and nearly 100 per cent. over the earnings of the next preceding year. During the year 1905-06, 11,988 barrels of fuel oil were used.



THE BOILER ROOM



BUCKEYE ENGINE BELTED TO THE RESERVE GENERATOR

The present rate for the ordinary private consumer is 7½ cents per kilowatt-hour, with a minimum monthly charge of one dollar. In order to secure a reasonable day load, the rate for power has been set at 3½ cents per kilowatt-hour. The city is charged $4.50 per month for each arc-lamp maintained for public lighting.

In the residence and outlying districts the streets are lighted by incandescent lamps, usually of 25 candle-power, supported singly by iron brackets fastened to the street poles. These are supplemented by arc-lamps suspended from steel towers in groups of three, or from pole brackets or span-wires. The incandescent lamps are connected in series on 2400-volt circuits. There are at present about 150 arc-lamps and 500 incandescents in use. About 50 more arc-lamps are to be installed in the near future.

On Park street, which is the principal business street of the city, the street-lamps are of the type shown in the accompanying photograph, being similar to those in use on Spring street, Los Angeles. Each lamp requires about 280 watts.

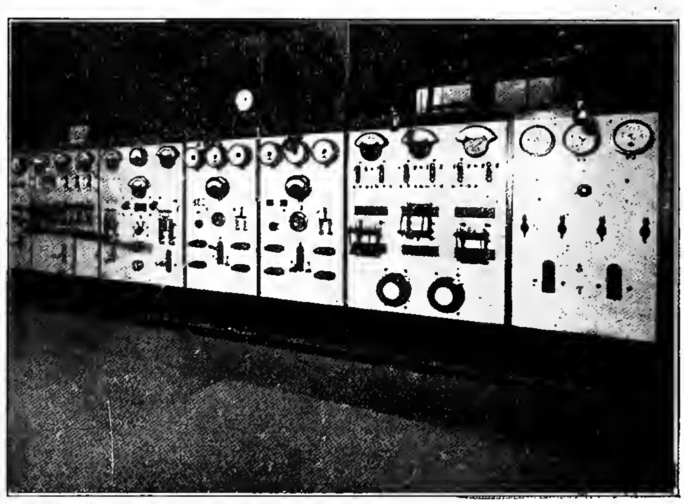
On June 30, 1906, the city had 1,424 poles in use on the streets, supporting 174 miles of wire, distributed as follows:

Commercial circuits, primary	70 miles
Commercial circuits, secondary	65 miles
Street lighting, arc circuits	27 miles
Street lighting, incandescent circuits,	12 miles

Transformers to the number of 214 were in use at that time, and 1,039 watt meters were installed on the premises of private consumers.

The power-house is a large wooden building situated at the foot of Park street, about 200 feet from the beach, washed by the San Francisco Bay. In the rear of the building are the water and fuel oil tanks and the stable for the horses used by the department. The City Trustees recently purchased an adjoining lot for the storage of construction materials.

To improve the service and meet the demand for electrical power, two new units having an aggregate capacity of 720 horse-power were installed within the past two years,



THE SWITCHBOARD.

while the auxiliary equipment was overhauled and extended so as to modernize the entire plant. On account of its proximity to the Bay, all the engines are operated condensing.

Of the three units now in operation, the oldest was installed about ten years ago and is now used only as a reserve. The engine is a Buckeye, cross-compound, double-valve engine, 17½ by 32½ inches, by a 32-inch stroke. The flywheel is 15 feet in diameter, from which a 32-inch belt drives a Stanley 240 kilowatt, 2400-volt, two-phase, induction type, alternating current generator. This machine generates at 66 cycles, thus making it impossible to parallel it with the new 60-cycle machines. It is, therefore, only used on independent circuits. The exciter is a Mather, two-pole machine, belted to the shaft of the generator. It supplies exciting current at 120 volts.

and is similar to the one just described. The exciter for this second direct connected unit is a duplicate of the exciter for unit No. 2.

Direct connected to this alternator is also a Harrisburg tandem-compound engine, but of the four-valve type, embodying many of the most modern features of steam engine design. The speed-changing device is electrially operated by two General Electric, direct current, series motors of ¼-horse-power rating, mounted on the flywheel. The speed is varied by the manipulation of a switch on the main switchboard. The engine is rated at 360-horse-power and is of dimensions, 17½ by 34 by 22 inches.

At night, and when the day load is heavy, the two National alternators are operated in parallel, being brought into synchronism with the aid of a General Electric synchroscope mounted above the switchboard.

THE CITY PARK WHERE THE FEEDWATER WELL IS LOCATED.

About two years ago a new unit was installed, which consists of a Harrisburg 360 horse-power, tandem compound, side crank, piston-valve engine direct connected to a National two-phase, 2400-volt alternator. The size of the engine is 19 by 32 by 20 inches. The speed-changing device is operated by a handwheel through a worm gearing. The alternator is a 48-pole machine of the revolving field type, and is rated at 240 kilowatt at 150 revolutions per minute. The field excitation is supplied by a belted, National, 26-kilowatt, 125-volt generator running at 1,225 revolutions per minute.

The third unit, which completes the generating equipment of this plant, has been in operation about a month. The alternator is a National machine of 275-kilowatt capacity

Current for the arc-lights is supplied by three Westinghouse air-cooled, regulating transformers of primary voltage equal to 2,400, and of full load capacity of 150 lights.

The remodeled switchboard consists of seven marble panels set out about five feet from the front wall to facilitate the repairing and changing of connections. The instruments are mainly of the Westinghouse or Stanley manufacture. General Electric expulsion fuses are placed between the bus bars and the line, and the main switches are oil-enclosed of the Westinghouse make. The resistance boxes for the alternator fields are mounted above the switchboard, being controlled by a handwheel through an endless chain.

Alternating current only is supplied by this plant. With the exception of the constant current maintained on the arc-lamp circuits, power is distributed from the bus-bars at 2,400 volts.

The gauge board is placed so as to be easily seen from any of the three units. There are on this board a steam gauge for indicating boiler pressure, three gauges for indicating the pressures in the different engine receivers, two vacuum, gauges, a Bristol recording gauge, and an Ashcroft clock.

The engines exhaust into two Deane jet condensers, 10 by 20 by 24 inches, arranged with independent suction from the Bay, a distance of about 200 feet. The heated water from these is passed through a Day feed water heater and purifier, rated at 500 horse-power, placed in the adjoining fire-room. The feed-water is normally fed to the boilers from the heater at a temperature of 197 deg. F.

There are two Worthington duplex steam pumps, 6 by 4 by 6 inches, duplicate connected on both the steam and suction ends. Each pump has a gauge to indicate the pressure in the feed-water mains. One pump is controlled by an automatic regulator connected to the heater, and the other from the main steam header.

Four boilers of the return flue, tubular type, are set in battery, with a steel stack for each two boilers. These four boilers are each rated at 135 horse-power and are 6 feet in diameter an 16 feet long. Each furnace is equipped with a "Little Giant" oil burner.

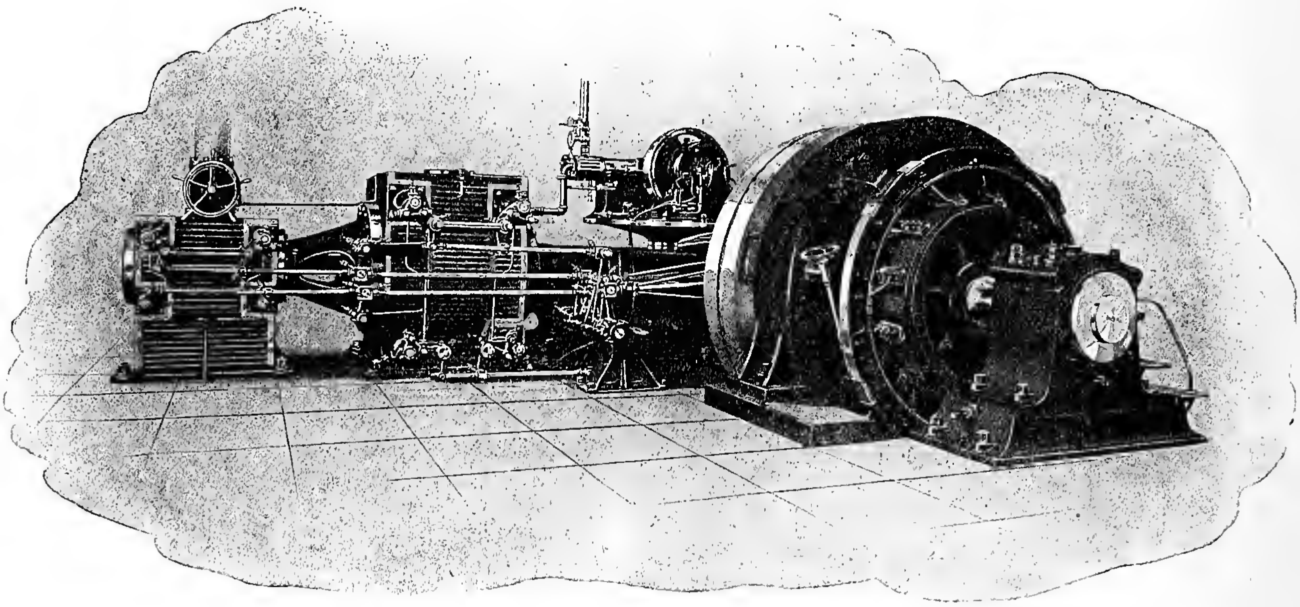
The steam main and the separators of each engine drain into 12-inch Crane steam traps, which discharge into the header of the feed water heater. Steam is supplied to each engine through 6-inch steam pipes.

The fuel oil is pumped from the storage tanks by two Smith-Vaile duplex oil pumps, 4½ by 3 by 4 inches, doubly connected to the suction pipes. A Worthington oil meter registers the quantity consumed in gallons.

There are four wooden oil tanks of about 1,000 barrels capacity, placed in pits in the rear of the power-house. Since the bottoms of the tanks are below the water line, they are securely anchored, as otherwise they would tend to float in the accumulated water. According to the existing contract, the cost of fuel oil per barrel delivered to the tanks is 75 cents.

Feed water of an excellent quality is obtained from a 12-inch well recently sunk in the City Park, about 1,200 feet away. The well is 249 feet deep. The water is pumped to the tower near the power house by a pump driven by a Westinghouse 2-phase, 10 horse-power, 220-volt motor, controlled by an auto-starter, in the fire-room. The stroke of the pump is indicated by an incandescent lamp placed in a circuit alternately opened and closed by contacts on the arm of the pump rod. The two tanks, mounted one above the other, have a capacity of about 15,000 gallons. They are elevated to such a height that the water is fed to the boilers under a 20-foot head.

Mr. Jos. B. Kahn, the present superintendent of the plant, is also the city electrician and superintendent of the fire alarm systems, which are operated by storage batteries.



TYPE OF HARRISBURG FOUR-VALVE ENGINE IN USE IN ALAMEDA MUNICIPAL PLANT.

STANDARD CELLS.

Messrs. K. E. Guthe and C. L. von Ende gave some interesting particulars concerning the performance of standard cells in a paper which they presented at a meeting of the Physical Society at Chicago. They constructed some standard cells with electrolytic mercurous sulphate prepared by themselves and with sulphate received from Dr. Hulett. The agreement between the E. M. F.'s for cells of the same series is within 2 in 100,000. Slight variations in the method of construction were made, and their influence upon the E.M.F. determined. Comparison of these new cells with those used last year for the obsolete determinations showed that the Clark cells agreed with the old, but that the cadmium cells had a considerably higher E.M.F. than the old, the changes of which were quite irregular. The authors found that while the initial E.M.F. of the new cadmium cells agrees very closely with the value found by Hulett for freshly set up cells, it decreases rapidly in a few weeks, and has now a value of 0.001 volt lower than at first. Mercury distilled twice in an ordinary vacuum still gives the same results as mercury distilled by Hulett's method. No difference was noticed between amalgam prepared in the usual way and electrolytic amalgam. Clear and cloudy cadmium sulphate crystals produce no difference in the E.M.F. of the cadmium cells. Clark cells with electrolytic coarsely-grained mercurous sulphate have immediately after construction an E.M.F. of 1.4204 volts at 25 deg. C. within a few hundred-thousandths of a volt, and remain constant in course of time. Cadmium cells with practically identical electrical behavior cannot be constructed at the present time.

POWER DISTRIBUTION FOR ELECTRIC RAILWAYS

Mr. Elbert G. Allen.*

In laying out feeder systems for distributing low voltage current to electric railways there are three objects to be kept in mind:

First, to provide sufficient copper that the feeders may not be dangerously overheated by the amount of current they convey.

Second, to provide sufficient voltage at all points that the desired schedules may be maintained without forcing the motors to a dangerous degree.

Third, to keep the actual power loss in the feeder circuit to an economical point.

As a rule in all but very short urban feeders the first object is attained in providing for the other two, but it should never be overlooked. The lack of voltage being the thing which is usually reported in a case of insufficient copper, too great stress is often laid on this requirement to the detriment of the others, particularly the third.

The simplest form of feeder system is that in which the working trolley is the only conductor employed, and is uniform in size from end to end. The so-called ladder system (Fig. 1) of feeder arrangement is a simple modification where the trolley being insufficient, a second wire is connected in multiple with it.

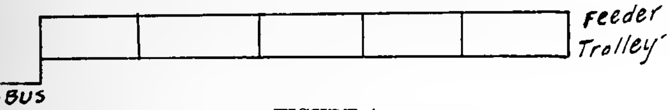


FIGURE 1.

If more copper is desired near the station end where the current density is greater it may be provided by using a tapering feeder or as is more practical, by adding short lengths of additional conductors at this end (Fig. 2).

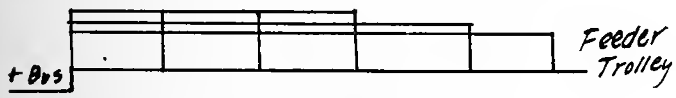


FIGURE 2.

In order to maintain a more uniform pressure from end to end of the trolley, the feeders are sometimes kept separate as in Fig. 3.

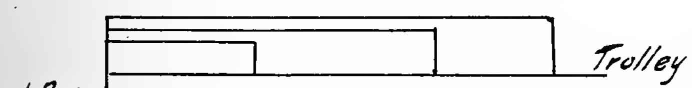


FIGURE 3.

In any of these cases the trolley may be sectionalized and switches placed in the feeder taps so that sections may be killed in case of fire, etc.

Many combinations of these simple feeder systems may be made, as for example, in Fig. 4, where the station end is fed by a tapered feeder and pressure held up on the remote end by a separate feeder.

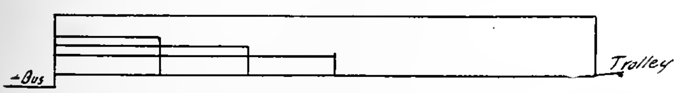


FIGURE 4.

This scheme is often employed where some particular point of the line, as a long steep hill, requires particularly large feeder capacity. It is also employed frequently where the pressure at the outer end of a line is held up by a "boosted feeder."

In the calculation of feeder systems it is necessary to make some assumptions of size and distribution of loads. In interurban service it is often possible to assume actual locations and size of loads from current time curves, but for urban and suburban work it is often more satisfactory to assume a distributed load. In the average case where grades are not excessive a uniform distribution of load may be satisfactorily assumed.

In figuring economical distribution of copper, two objects may be kept in mind, the delivery of a specified minimum voltage or the maintenance of a specified maximum loss. It can be easily proved that with uniform distribution of load the cross section of total copper should vary as the square root of the distance from the far end for minimum weight of copper to give a given voltage drop. For minimum copper with a given watt loss, the section of copper should be directly proportional to the distance from the far end.

Taking the case where a given maximum voltage drop is desired since the cross section of copper is to vary as the square root of the distance from the far end,

$$y = k\sqrt{x}$$

where y equals c.m. area of copper at distance x from the end.

$dv = \frac{10.5\,axdx}{y}$ = drop in an elementary section of feeder where a = current distributed per unit length of feeder.

$$\text{Then } dv = \frac{10.5\,a\sqrt{x}\,dx}{k}$$

$$v = \frac{10.5\,a}{k}\int_0^L \sqrt{x}\,dx = \frac{10.5\,a}{k}\cdot\frac{2}{3}\left(L\right)^{\frac{3}{2}} = \text{Total drop}$$

$$k = \frac{2}{3}\,\frac{10.5\,A}{V}\sqrt{L}$$

where L = total length of line,
A = total length of amperes,
V = maximum drop in volts.

For example, a road 15,000 feet long with No. 00 trolley giving five minutes' service with 18-ton cars at schedule speed of 45 minutes for the round trip, is assumed to consume 135 watt hours per ton mile, with a 40 per cent load factor.

No. of cars = 9,

$$\text{Average load} = \frac{9 \;.\; 18 \;.\; 30000 \;.\; 4 \;.\; 135}{3 \;.\; 5280} = 165 \text{ kilowatts}$$

Max. load = 410 K. W. or 685 amps.

Allowing 100 volts' drop to the end we find,

$$k = \frac{2}{3}\,10.5\,\frac{685}{100}\sqrt{15000} = 5870$$

$$y = 5870\sqrt{x}$$

This curve of distribution of copper is shown in Fig. 5. The total circular mill feet required is 7,200,000,000.

Such a distribution is of course impractical, and commercially we would substitute steps composed of standard size copper. For example we might use

No. 00 Trolley - - -	15000 feet.
No. 4/o Feeder - - -	5000 feet.
500,000 C. M. Feeder - -	8500 feet.

Total C. M. feet = 7,308,000,000
Actual drop = 102 volts,

which, employing 1½ per cent more copper, gives only 2 per cent excess drop over that obtained by a theoretical distribution.

*Lecture delivered January 9, 1907, to Class in Electric Railways, in the University of Washington, Seattle, Wash.

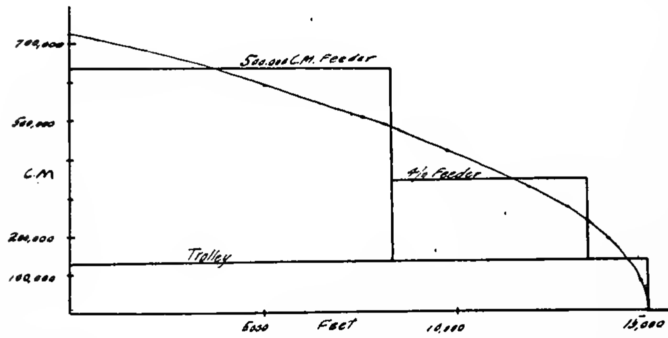


FIGURE 5.

For the calculation of stepped feeders the following formula is useful:

Fig. 6, let a = current per unit length,

$$\text{Drop in } dx = \frac{10.5\, ax\, dx}{y_2}$$

$$\text{Total drop in section} = \frac{10.5\, a}{y_2}\int_{l_1}^{l_2} x\,dx$$

$$= \tfrac{1}{2} 10.5\, a \left[\frac{l_2^2 - l_1^2}{y_2}\right]$$

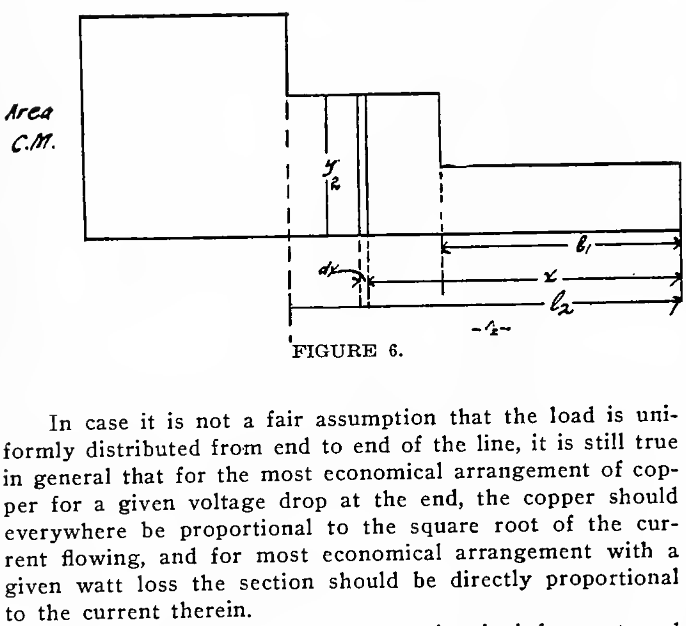


FIGURE 6.

In case it is not a fair assumption that the load is uniformly distributed from end to end of the line, it is still true in general that for the most economical arrangement of copper for a given voltage drop at the end, the copper should everywhere be proportional to the square root of the current flowing, and for most economical arrangement with a given watt loss the section should be directly proportional to the current therein.

With suburban roads where service is infrequent and there are portions of the route which have a specially heavy demand, it is frequently better to assume concentrated loads rather than assume a uniform distribution. It is usually sufficient to assume a case where one car is at the extreme end of the line, all others being located in their proper place according to schedule and assign loads to the various cars in accordance with the character of the road where they are located. The sum of the loads should correspond to the assumption for the total maximum loads, and starting demands should be assigned to the more remote cars in order that extreme conditions may be figured on.

If a section of road is fed from both ends and a concentrated load is assumed, as is the case with an ordinary interurban road with several sub-stations, it is usually best to have the conductor of uniform cross section from station to station unless there are points of unusually heavy demand. This follows from the propositions given above for economical distribution of copper, as the current is the same in all sections from the train to the sub-station.

All the above discussion refers to the positive feeder only, and neglects the resistance of the return conductor. Steel rail is of very variable resistance, depending on the composition. The purer and softer the steel the better is its conductivity. Manganese most affects the conductivity, while phosphorus also increases the resistance greatly. It is generally safe to assume that steel has about one-seventh the conductivity of copper, or perhaps a little less. The equivalent section of copper in circular mills is then equal numerically to about 16,000 times the weight of the rail in pounds per running yard. The return circuit has then a resistance of from 0.1 or 0.2 that of the positive circuit with very good conditions on small systems, an amount nearly equal to it with poor conditions on very large systems. In the ordinary suburban case the return resistance is about one-third the positive resistance. One very good way of taking care of the return resistance in approximate calculation is by substituting 14 for 10.5 as a value of specific resistance in the ordinary formulae for voltage drop. It is usually best, however, to take care of it by some more close method, figuring the equivalent amount of copper resistance added by the rail circuit.

In the foregoing we have assumed that rail joints add nothing to the resistance of the track circuit. This is hardly true, except possibly for newly bonded tracks under the best conditions. An ordinarily well bonded track should not, however, show less than 85 to 90 per cent of the conductivity of an equal length of continuous rail.

The assumption has also been made that the track forms the sole path for the return of the current. This also is not true, although it is sufficiently near the truth to form a conservative basis for the calculation of voltage drop. In accordance with Ohms law the return current follows all possible paths in proportion to their conductivity. Iron, water, and gas mains not infrequently form a path of fairly good relative conductivity. Such diversion of the return current opens the way for electrolytic troubles, for wherever the current leaves a metal electrolysis will take place, provided there is a suitable electrolyte present. The best electrolytes are chlorides, nitrates, or sulphates. The mere passage of current over a pipe does not necessarily imply that electrolysis is taking place, for there must be a departure of the current from the pipe through a proper electrolyte. Neither does the presence of a pitted or worn pipe near a railway track necessarily imply electrolysis. Probably every pitted and thin pipe whose condition is attributed to electrolysis can be duplicated by similar pipes that have never been in a locality where electric current could pass through them, and have been acted on by chemical agencies only. A difference in potential between pipe and rail is not true measure of the amount of current passing between them or the amount of electrolysis taking place. It does, however, indicate the tendency towards electrolytic action, and is often valuable as evidence of the condition of the rail circuit. If the negative terminal of the generators is connected to the rail the rail assumes a negative potential with respect to the surrounding earth in the vicinity of the powerhouse, and a positive potential in outlying districts. The district where the rail is negative is called the danger district, for it is here that current tends to leave pipes for the rail and cause electrolysis of the pipes.

If the network of pipes is connected to the negative terminals of the generators, no electrolysis can take place as before by the current leaving the pipe, but electrolysis is liable to take place at all rail joints where conductivity from section to section of the pipe is poor and current tends to flow through the earth.

The best preventative of electrolysis is good bonding, which tends to keep the current in the rails. In case the current density becomes so high that the difference in the potential in the danger district becomes more than four or five volts, the rail should be supplemented with ground feeders. In some instances where pipes are particularly liable to damage, it is wise to lay a ground feeder paralleling the pipe and connected to it every few pipe lengths throughout the danger district.

SINGLE-PHASE VS. THREE-PHASE POWER TRANSMISSION.

Ernest Van Loben Sels.

It has become an accepted principle among electrical engineers that mathematically one-quarter of the copper in a transmission line is saved by the use of three-phase transmission. Of course, there can be no doubt that three-phase transmission requires one-quarter less copper for the same voltage between the wires, than the single or two-phase systems, but it is worth while to see how that saving is effected.

Since the copper in any given system varies inversely as the square of the voltage, and since the limit to higher voltages is only the capability of the insulation to withstand the increased strain, it follows that the condition for comparison of single with three-phase transmission must be an equal strain on the insulation in either case.

Now, in wet weather—and this is the most unfavorable condition for the insulators, and, therefore, the one to be considered—the pole and cross-arms become conductors connected to earth, and, therefore, their potential is and remains zero throughout the cycle, regardless of any inequality of leakage over the insulators. In dry weather the sum of the leakages from all the insulators on one pole, which would be zero in any balanced system if the insulators were all equally clean, may affect the potential of the pole to some extent, due to an unequal accumulation of dirt and moisture on the insulators, making the potential rise and fall in step with the wire over the dirtiest insulators. In practice, however, this effect will be small compared to the line voltage, because (a) the insulators must be kept clean enough to minimize the leakage in order to avoid destructive carbonizing; (b) the leakage would be very small in dry weather, as the dry dirt is not a good conductor. What little variation there may be is likely to occur in both single and three-phase transmission, so that, both systems being affected alike, this variation from zero potential may be neglected, and the potential of the pole considered to be always zero.

The voltage which the insulators of a three-phase transmission line must be designed to withstand is, therefore, the maximum difference of potential between any one wire and the neutral. The insulators being merely a set of high resistances star-connected, and each insulator is subjected to the same strain as would each of a set of star-connected transformers. Of course, for purposes of comparison, while dealing with the same wave-form in the two systems, it is perfectly allowable to use the mean effective voltage instead of the maximum voltage, because they bear the same ratio to each other in both systems. Making this substitution, the insulators in a single-phase line with a line voltage=E, would each have to withstand E/2 volts, while, for the same voltage between the wires in a three-phase, star-connected line, each insulator would have to withstand $\frac{E}{\sqrt{3}} = \frac{E}{1.732}$ volts. If the voltage be raised on the single-phase line to $\frac{2E}{\sqrt{3}} =$ 1.155-E, the strain on the insulators would then be equal to that on those of the three-phase line with E volts between the wires. If E_3 and I_3 represent voltage and amperage in the three-phase line, and E_1 and I_1 the voltage and amperage in the single-phase line, then for a power of P watts at power-factor p, we have in the three-phase line $P = \sqrt{3}\, p\, E_3 I_3$ or $I_3 = \frac{P}{\sqrt{3}\, p\, E_3}$ and in the single-phase line $P = p\, E_1 I_1 = \frac{p\, 2 E_3}{\sqrt{3}} I_1$ or $I_1 = \frac{P\sqrt{3}}{2p E_3} = \frac{P}{\sqrt{3}\, p\, E_3} \cdot \frac{3}{2} \cdot : \frac{I_1}{I_3} = \frac{3}{2}$ for the same power, power-factor and the same strain on the insulation. That is, the current in each of the two single-phase wires would be fifty per cent greater than the current in each of the three three-phase wires. Consequently the total current in all the wires of one system would equal the total current in all those of the other, and, under these conditions, the copper required would be the same for both systems.

Incidentally, the wires of the single-phase system would have to be spaced fifteen and one-half per cent, further apart if it is desired to keep the same factor of safety on the atmospheric dielectric—and it must be noted here that this is the only part of the whole system which would be subjected to a greater strain than would be incurred with a three-phase line with the same voltage between wire and neutral. The cross-arms would therefore be a little longer than would be necessary for our three-phase line—a trivial item which would be more than counterbalanced by rendering unnecessary the extra length of pole required to support the third conductor of a three-phase line.

In conclusion, then, it is evident that while for the conventional comparison with equal voltage between the wires, the three-phase system shows a saving of twenty-five percent. of the copper in the transmission line, this saving is not effected by any inherent superiority of this form of transmission, but is only secured by increasing the strain on the insulators; and that, if the voltage be raised on the single-phase system until the same strain is imposed on the insulators, then both systems require the same quantity of copper, but the single-phase system requires one-third less insulators, insulator pins and lightning arresters. This means not only a smaller first cost for the single-phase line, but also one-third less insulators to keep clean and replace when broken, and less chance for a ground. Indeed, to claim any superiority for the three-phase system on the ground of saving in copper in this manner is on a par with advocating shallow trusses for bridge construction on the ground that metal is saved by shortening the vertical and diagonal members; and all the while not taking into consideration the fact that the strains in most of the members will thereby be increased. and that therefore any saving in metal is only effected at the expense of the safety factor.

In the transmission of power running high up into the thousands of kilowatts, this saving of one-third of the insulator pins and lightning arresters may not be worth taking into consideration as against the great advantages of the three-phase system; the greater starting torque of all three-phase motors, less tendency to hunt and get out of step, and the higher efficiency and lesser weight of both generators and motors. But in the transmission of power in small quantities the matter is entirely different. Experience has proved that small wires are objectionable because they break too easily. Consequently in transmitting only a few hundred kilowatts an amount of copper is used in excess of the requirements for the power transmitted. In such a case one-third of the copper can be saved by transmitting single-phase and using only two wires. The question of the advisability of transmitting single-phase will then depend on the use to which the power is to be put. For electric lighting purposes single-phase current shows some advantages over three-phase current because it is easier to balance the two sets of lights in a three-wire, single-phase system, than to balance the three sets of a three-phase, four-wire system. Similarly single-phase current is better for charging storage batteries or for any electrolytic purpose whatever, as it requires but one mercury arc rectifier as against three in the three-phase system—quite an advantage when small amounts of power are so used. Where there is no objection to a frequency of twenty-five cycles, single-phase current is vastly superior to three-phase for electric traction, as the former can be used directly, without the interposition of any other machinery than step-down transformers in the "single-phase" railway motor—an ordinary series motor with laminated poles, and designed for minimum sparking. For long-distance traction this arrangement greatly reduces the size of trolley feeders and the number of sub-stations required, as well as eliminating all rotating machinery.

Furthermore, the single-phase railway motor, which is only recently on the market, has undoubtedly many other possibilities as yet unexploited. Thus it could undoubtedly

be used for driving hoists and elevators, as its characteristics make it peculiarly fit for work requiring very high starting torque, and running at variable speed. In fact, it might even be adapted for operating machines in machine shops where the individual drive is introduced. Geared directly to its machine, all speed variation over any ratio desired could be obtained by varying the e. m. f. delivered by a transformer, doing away entirely with resistance coils, as in a D. C. machine. In fact, it should compare well with D. C. motors in regard to average running efficency, as its greater efficiency at low speeds should more than offset its lower efficiency at full speed. Then ordinary single-phase motors can be used for driving machinery that can be started up under no load, and where the load is constant, as, for instance, centrifugal pumps, fans, etc.; and single-phase rotary converters are entirely satisfactory for generating D. C. current. Also in small motors generally, where a friction clutch can be used and the motor started off by hand, single-phase current can be used.

On the other hand, where heavy machinery must be started under full load, and the load is intermittent, as in mills for instance, a single-phase motor would be an impossibility, and the question of the advisability of transmitting single-phase where part of the power is to be used for such a purpose, would depend on the relative amounts of power to be used for this and for other purposes, more suitable to single-phase current—or whether the mills were so located that they could be supplied with D. C. current from one central sub-station in connection with a storage battery, for instance. This question must be solved with especial regard to the peculiarities of each individual case. Enough has, however, been said to show that the much-maligned single-phase transmission of power is not without its advantages, and that there is quite a field in small power transmission where it is superior to three-phase transmission.

ON THE SUBSTITUTION OF THE ELECTRIC MOTOR FOR THE STEAM LOCOMOTIVE.

Few subjects which are to-day engaging the attention of the engineering world are comparable either in scientific interest or in practical importance to the substitution of the electric motor for the steam locomotive engine. On the Valtellina line and through the Simplon tunnel 70-ton electric locomotives, with three-phase motor equipment, capable of developing a draw-bar pull of 28,000 lbs., have displaced the steam locomotive, with results showing both marked improvement in service and substantial economy in operating costs. In the New York subway, eight-car trains weighing 320 tons are in operation, equipped with motors developing during acceleration a tractive effort equivalent to a draw-bar pull of 55,000 lbs. The heaviest passenger locomotive used on the Erie system weighs, exclusive of tender, 206,000 lbs., of which 55.8 per cent., or 115,000 lbs., is effective on drivers. Assuming the adhesion to be 20 per cent., such a locomotive exerts a draw-bar pull of 23,000 lbs. The motors of the eight-car electric train of the New York subway, therefore, exert a tractive effort equivalent to more than twice the draw-bar pull of this locomotive.—Extract from address by Lewis B. Stillwell and Henry St. Clair before the American Institute of Electrical Engineers.

AN IMPROVEMENT IN ELECTRIC SIGNS.

Brilliant effects for electric signs are now to be readily obtained with little cost by the use of small, colored, transparent caps which fit over the rounded ends of the incandescent bulbs. This permits the owner of a changeable electric sign to alter the legend at will and to indulge in the use of colors without the necessity of keeping on hand a large supply of colored lamps, some of which are very expensive.

LIMITING CAPACITIES OF LONG-DISTANCE TRANSMISSION LINES.

Clarence P. Fowler.*

The amount of power which can be commercially transmitted over a long-distance transmission line is usually limited by the voltage regulation. The voltage regulation is the drop in voltage caused by the transmission line. It is the difference between the voltage measured at the power house and the voltage measured at the receiving station, and is usually expressed as a per cent. of the normal voltage at the receiving station. The drop in voltage is dependent upon the resistance of the line, its inductance, the frequency, the current and the power-factor of the load.

The method of obtaining the resistance of the line is well known. The inductance at a given frequency depends upon the size of the conductors and their distance apart. The inductance volts for given conditions are found from tables. The resistance volts and the inductance (or reactance) volts may be combined as two sides of a right angle triangle, the hypothenuse of which gives the line impedance. This represents the electro-motive force which would be required for sending the current through the line when short-circuited at the receiving end.

The effect of the above-mentioned line conditions, namely, the resistance volts, the inductance volts and the power-factor of the load, upon its voltage regulation is given in Table I. It will be noted by an examination of this table that the total drop when the power-factor of the load is 100 per cent. is dependent almost entirely upon the resistance and very little upon the inductance of the line; whereas, at low power-factors the inductance is a very important factor in determining the total drop. This table, it may be remarked, is applicable not only to long-distance transmission lines using high voltage, but also to all circuits which have both resistance and impedance, whether these elements be in the conducting wires themselves or in impedance coils or other devices.

At the 20th annual convention of the American Institute of Electrical Engineers in 1903, Mr. P. M. Lincoln presented a paper, entitled "Choice of Frequency for Very Long Lines." One of the elements which he takes up is the limit

TABLE I.

Total Drop at Power-factors Ranging from 60-100 Per Cent., with Different Percentages of Resistance and Inductance Volts, in Transmission Circuits.

Per Cent of Received E. M. F.		Per Cent Total Drop for Power-Factors of					
Resistance Volts	Inductance Volts	100 %	95 %	90 %	85 %	80 %	60 %
5	3	5.	5.75	6.0	6.0	5.9	5.5
5	5	5.1	6.5	6.9	7.0	7.0	7.0
5	10	5.4	8.2	9.2	10.0	10.1	11.0
5	15	6.0	10.1	11.8	12.8	13.3	15.0
10	5	10.0	11.0	11.3	11.25	11.0	11.0
10	10	10.4	12.8	13.6	14.0	14.0	14.0
10	15	11.0	14.8	16.0	16.8	17.0	18.0
10	20	11.8	16.9	17.75	19.9	20.3	22.0
15	10	15.4	17.5	18.0	18.0	18.0	17.0
15	15	16.0	18.8	20.3	21.0	21.0	21.0
15	20	16.8	21.0	23.0	24.0	24.0	25.0
15	30	18.8	26.0	28.3	30.0	31.0	33.0
20	15	21.0	24.0	24.9	25.0	25.0	24.0
20	20	21.6	26.0	27.1	27.9	28.0	28.0
20	30	23.7	30.2	32.5	33.8	35.0	36.0
20	40	26.3	35.2	38.3	40.0	41.5	44.0

*From the "Electric Journal."

of power which can be transmitted over a given line without exceeding certain limits as to voltage regulation. He gives the limiting kilowatts which may be transmitted under definite conditions at a distance of 200 miles.

The method suggested by Mr. Lincoln has been worked out for a wider range of conditions, and the results are given in Table II. In this table it is assumed that power is delivered from a three-phase line, that the conductors are six feet apart and equidistant, that the size of conductors is such as to give approximately fifteen per cent. resistance loss, and that the power is delivered at eighty-five per cent. power-factor. If the size of wire be changed, the effect upon the inductance volts will be very slight—for example, if the size of wire be increased so that the loss is reduced as much as fifty per cent., the inductance volts will likewise be decreased, but only a few per cent.

Mr. Lincoln, in the paper above referred to, makes the following statement with regard to charging current:

"Charging current is, of course, a direct function of frequency and voltage and, to a slight extent, of line construction. At 60 cycles the apparent energy represented by the charging current in a 200-mile, three-phase line is practically equal to the ultimate capacity of that line as limited by the twenty per cent. inductance volts consideration. At twenty-five cycles it is only about 15 per cent. of the ultimate capacity as limited by the same consideration. In a sixty-cyle installation, therefore, it is necessary either to operate the generators on such a line at about full-current output all the time, no matter what the load, or to compensate for the charging current in part or in whole by the installation of choke coils, either horn of which dilemma is not pleasant to consider. The problem of taking care of the charging current at twenty-five cycles does not enter the discussion as compared with sixty cycles.

TABLE II.

Approximate Kilowatts at Power-factor of 85 Per Cent; Inductance Volts 10, 15 and 20 Per Cent.; Distance 50, 75, 100, 150, and 200 Miles; Line Voltage, 20,000-100,000 Volts.

Distance and E. M. F.	10 per cent Inductance Volts		15 per cent Inductance Volts		20 per cent Inductance Volts	
	60 cycles	25 cycles	60 cycles	25 cycles	60 cycles	25 cycles
50 Miles						
20 000	900	2 300	1 400	3 500	1 800	4 700
30 000	2 000	5 300	3 000	7 900	4 000	10 600
40 000	3 600	9 400	5 400	14 100	7 200	18 800
50 000	5 600	14 700	8 400	22 000	11 200	29 400
60 000	8 100	21 200	12 200	31 700	16 200	42 300
80 000	14 400	37 600	21 600	56 400	28 800	75 200
100 000	22 500	58 700	33 700	88 000	45 000	117 500
75 Miles						
20 000	600	1 600	900	2 300	1 200	3 200
30 000	1 300	3 500	2 000	5 300	2 700	7 000
40 000	2 400	6 300	3 600	9 400	4 800	12 600
50 000	3 700	9 800	5 600	14 700	7 500	19 600
60 000	5 400	14 100	8 100	21 200	10 800	28 200
80 000	9 600	25 000	14 400	37 600	19 200	50 000
100 000	15 000	39 200	22 500	59 000	30 000	78 400
100 Miles						
20 000	450	1 200	700	1 700	900	2 300
30 000	1 000	2 600	1 500	3 900	2 000	5 300
40 000	1 800	4 700	2 700	7 000	3 600	9 400
50 000	2 800	7 300	4 200	11 000	5 600	14 700
60 000	4 000	10 600	6 100	15 400	8 100	21 200
80 000	7 200	18 800	10 800	28 200	14 400	37 600
100 000	11 200	29 500	16 900	44 000	22 500	59 000
150 Miles						
20 000	300	800	450	1 200	600	1 600
30 000	650	1 700	1 000	2 600	1 300	3 400
40 000	1 200	3 200	1 800	4 700	2 400	6 400
50 000	1 800	4 900	2 800	7 300	3 700	9 800
60 000	2 700	7 000	4 000	10 600	5 400	14 000
80 000	4 800	12 500	7 200	18 800	9 600	25 000
100 000	7 500	19 600	11 200	29 500	15 000	39 200
200 Miles						
20 000	225	600	350	850	450	1 100
30 000	500	1 300	750	1 900	1 000	2 600
40 000	900	2 300	1 300	3 500	1 800	4 700
50 000	1 400	3 600	2 100	5 500	2 800	7 300
60 000	2 000	5 300	3 000	7 700	4 000	10 600
80 000	3 600	9 400	5 400	14 100	7 200	18 800
100 000	5 600	14 700	8 400	22 000	11 200	29 500

"The effect of a large charging current on the regulation of the generator should also be considered. As is well known, a line-charging current, when circulated in a generator armature, has the effect of assisting the field ampere turns to magnetize the fields. The percentage of magnetizing done by this charging current depends upon its amount and the inherent regulation of the generator. Since the charging current depends upon the voltage, the generator exciting power of the charging current also depends upon the voltage. The effect of sudden load changes, therefore, which tend to change the voltage delivered, will in turn affect this element of the excitation. That is, to a certain extent, the generator assumes the regulation which inherently belongs to a direct-current shunt generator. The effect of large charging currents on generator regulation is therefore not toward an improvement."

As the charging current of a line 200 miles long is practically equal to the ultimate capacity of the line, when the frequency is sixty cycles and the inductance volts are twenty per cent., it follows that the charging current exceeds the normal working current when the inductance volts are less than twenty per cent. For distances less than 200 miles, the charging current is proportional to the distance and the power delivered is greater than for 200 miles. Consequently, the charging current is considerably less than the normal current for the conditions given in the table, except those for the greater distances and higher frequency and the lower inductance volts.

STUPENDOUS WATER SUPPLY SCHEME.

Three of the leading hydraulic engineers of the country have recently reported favorably upon what is probably the most daring municipal water supply scheme that has ever been projected. We refer to the proposal, which we understand, has every prospect of being successfully prosecuted, to supply the city of Los Angeles and the surrounding district with an abundant supply of water drawn from the distant Sierra Mountains. The scheme involves, first, the construction of a conduit 226 miles in length, capable of supplying the city with a quarter of a billion gallons of water daily; second, the construction of large storage reservoirs, a single one of which will have the enormous capacity of 85 billion gallons of water; and lastly, the development of a total of 100,000 horsepower, available for six days of the week and nine hours of each day, the greater part of which can be developed within a distance of 45 miles of the city. The total cost of this very ambitious undertaking will be about $25,000,000. The guarantee for planning this work on a scale of such magnitude is to be found in the certain and very large income to be derived from the sale of water for irrigation purposes and for power in and around a city which doubled its population in the ten years preceding the last census, and is recognized to-day as being, next to San Francisco, the most important commercial center in the flourishing State of California.—"The Scientific American."

A WHALEBONE DEPOSIT.

A landslide occurred in October on the Thompson ranch at Scott's Valley, at Santa Cruz, Cal., which uncovered a bed of whalebone which apparently has been there since the antediluvian period. The place where the pre-historic bones were uncovered is fully 600 feet above the sea level and six miles from the shores of Monterey Bay. Other discoveries of the kind have been made in various sections of the county, and scientists who have made a study of the geological formation of the soil at different times claim that the present site of Santa Cruz, extending as far back as the Santa Cruz Mountains, was once covered by an immense body of water.—Scientific American.

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EDITORIAL.

Electric Railway Engineering

In the field of electricity the development in connection with electric railways is of the greatest importance. Also, in the development of transportation systems, both for city service and interurban traffic, electricity has been extensively used, and, what is more important, very successfully. At the present time the engineering details involved in the installation of electric railways are in many respects different from that of either steam railway systems or the generation, transportation and distribution of electrical energy for power and light. It may, therefore, be said that electric railway engineering is in some respects a distinct field of engineering, and many matters to be considered by the electric railway engineer are different from either railway or electrical problems.

For nearly twenty years direct current at 500 volts, constant potential, has been used exclusively for electric traction purposes. Not until recently has alternating current been extensively utilized in connection with the series alternating current motor. For long lines the saving in copper, as well as increased efficiency, makes the alternating current railways in many respects superior to the direct current lines. The proper place for each is being determined today by actual installations, and although the alternating current motor requires excessive starting current as compared with the direct current motor, this advantage is being rapidly overcome and may be said to be of small importance compared to the many advantages incident to the use of alternating current direct for the motors on the cars.

Electrical energy today is primarily generated almost exclusively as alternating current, particularly where long transmission lines are required or very large units required. The elimination of sub-stations, lowering transformers, motor generator sets or rotary converters and costly feeders, all of which are necessary in long direct current 500-volt lines, gives the alternating current railway systems a decided preference, particularly as regards first cost. Judging from the reports of some of the alternating current railway systems in the East, their operation has been quite satisfactory, and in general as reliable as the 500-volt direct current lines.

Another important advance has recently been made in the substitution of 1,200-volt direct current in place of 500-volt direct current between the trolley and the rails, this increase in voltage resulting in a great saving of copper and extending the distances to which direct current lines may be economically operated. The joint use of 500 volts for city service and 1,200 volts for suburban service, using the same motors, cannot but be a great stride ahead in electric railway work, both within the city limits and for outside lines.

The Central California Traction Co., which was fully described in a recent issue of the "Journal," has an interurban system more than fifteen miles in length. Very soon there will be other lines in operation thirty-five miles from the generating station. The cars on the interurban lines will be operated from the 1,200-volt service. Within the city limits, where the cars must necessarily be operated at lower speed, a change is made from the 1,200-volt trolley to 550 volts. It is, of course, necessary that the auxiliaries on the car, such as the lights, heaters, air pump, etc., must be operated at the same voltage at all times. This is made possible by the installation of a direct current voltage changing device, which is nothing more than a motor generator set, which, when the cars are operated on outside lines, reduces the voltage from 1,200 to 550 volts. Upon entering the city, these motor generator sets are cut out and the auxiliaries operated directly on the trolley potential at 550 volts.

From the standpoint of the civil engineer, the grades and curves allowable on interurban lines are quite different from those ordinarily found on steam railway lines. This is, of course, due to the fact that single motor cars are usually operated on electric railway systems. Where electric locomotives have been installed to supplant steam locomotives, the track requirements are naturally the same as in the ordinary steam railway lines.

TRADE CATALOGUES.

The General Electric Company—Bulletin No. 4481 presents a type of Signal Relay for use in connection with railway signal apparatus. Several important points of superiority over any relay that has heretofore been used for this work are claimed, and the bulletin will be of interest to railway and signal engineers.

Bulletin No. 4482—A guide to the design of medium and small capacity central station switchboards. This bulletin will prove of assistance in the designing of small switchboards, as it represents by means of appropriate drawings the latest practice in alternating current switchboards.

Bulletin No. 4484 is devoted to Railway Signals, Top Mast, Direct Connected, Two and Three Position Type. These signals are motor-driven, and show a distinct advance in this class of apparatus.

Bulletin No. 4486.—This describes in detail the salient features of the General Electric Company's line of continuous current motors for constant speed service, which are known as the Type CQ, and range in capacity from 1-16 to 20 horsepower.

Price List No. 5159, superseding all previous issues, gives list prices of Edison Incandescent Lamps (Carbon Filament Type).

Price List No. 5160 (same as above) is devoted to Edison Miniature Incandescent Lamps, which include Candelabra Lamps, Decorative Lamps, and Battery Inspection Lamps.

Allis-Chalmers Co.—Bulletin No. 1038, a reprint on the subject of "Alternating Current Generator." It contains many illustrations showing different installations of the Allis-Chalmers' Alternators, and will be of value to all interested.

Bulletin No. 1415 on "Gates Rock and Ore Breaker," Style "D," superseding Catalogue No. 117. This machine has had a very large sale all over the world, being the first gyratory crusher to be placed on the market. This bulletin shows a number of improvements in design, workmanship and material, so that it will be found of interest to all users of such machines.

Publication No. 115, being directions for erecting Gates' Elevators. The matter in this is very plainly put with the aid of illustrations, and will, no doubt, be of value to all users of the elevator type of conveyors.

Electric Storage Battery Co.—The "Exide" Battery Instruction Book has just been revised by the Electric Storage Battery Co. The 1907 book is most complete and describes the various parts comprising the "Exide" battery, and gives in detail the method of operating and caring for the battery, as well as instructions for assembling and putting it in commission.

The book is not for sale, but is being distributed by the vehicle manufacturers, the "Exide" battery depots, and the "Exide" distributors, which are located in the principal cities throughout the country.

Upon request it will be furnished by any of the branch sales offices of the Electric Storage Battery Company.

The Risdon Iron Works.—The operation of gold dredgers has been described in a general way by the technical journals in articles which have always been of interest, but for a detailed description of all the parts, together with illustrations and drawings, we have seen nothing which compares with the new catalogue (No. 17) on gold dredging machinery issued by the Risdon Iron Works, San Francisco.

The Automatic Oil Cup Co. have just published a neat little bulletin devoted to Bang's Automatic Oil Cups. There are a number of illustrations and drawings showing the adaptability of this cup to any bearing. Applications for the bulletin should be sent to the Automatic Oil Cup Co., 155-59 Huron Street, Milwaukee, Wis.

The Sprague Electric Co. have sent out to the trade a very effective little folder showing the simplicity of Greenfield Flexible Steel Armored Conductors for an installation of electric lighting conductors as compared with the ordinary knob and tube system. This will appeal to all engineers and wiring contractors.

PERSONAL.

Mr. A. N. Hargrove, manager of the car department of Pierson, Roeding & Co., left on Wednesday morning for St. Louis and Philadelphia. While East he will visit the various factories of J. G. Brill Co. with a view to pushing forward the shipments of cars now building for Pacific Coast railroads. Pierson, Roeding & Co. report that during the past six months they have closed contracts for their principals, aggregating 144 cars with trucks, which is the equivalent of over $500,000 gross sales.

Jean Bart Balcomb of Brooklyn, N. Y., has resigned his position as chief engineer of the Pittsburg Filter Manufacturing Company, of Pittsburg, Pa., to accept a position as chief engineer of the Hudson River Concrete Company of New York City, with offices at No. 26 Court street, Brooklyn, N. Y.

Mr. H. G. Aylsworth has recently acquired an interest in the H. M. Estes Company, and will act as sales manager for this concern. The electrical lines formerly carried will now be represented by the Estes Company under the management of Mr. Aylsworth.

WESTERN ELECTRIC EMPLOYES DINE.

An informal dinner given to directors and department managers of the Western Electric Company was enjoyed by three hundred employes of the company at the Grand Pacific Hotel, Chicago, on the evening of January 28th. A minstrel show which followed the dinner proved a very enjoyable feature to all who listened to the many local jokes which were given.

President E. M. Barton delivered an interesting speech in which he reviewed the history of the company, which he said had grown from a small and comparatively insignificant organization to its present mammoth proportions.

Secretary C. G. DuBois, in his remarks, referred to the present status of the concern in the business world. His speech abounded in suggestions valuable to all interested in the system of conducting the business of a large corporation.

MONTANA WATERPOWER DAM COMPLETED.

The gates of the Hauser Lake dam, near Helena, Mont., were closed last week. This is said to be the largest dam of its kind in the world, and is to supply the waterpower to develop electricity for running the Washoe Reduction Works, the Anaconda railway, light cities and operate many of the Butte mines. It will be three weeks before the power is turned on, as it will take this time for the lake to fill. The water will back up 18 miles in the river and through the Prickly Pear Canyon, six miles in the valley below Helena.

The dam is 640 feet long and 70 feet wide, and is made of steel throughout. Fifteen thousand horsepower will be generated, and this, with the Canyon Ferry plant, will make Helena one of the largest producers of electricity in the country.

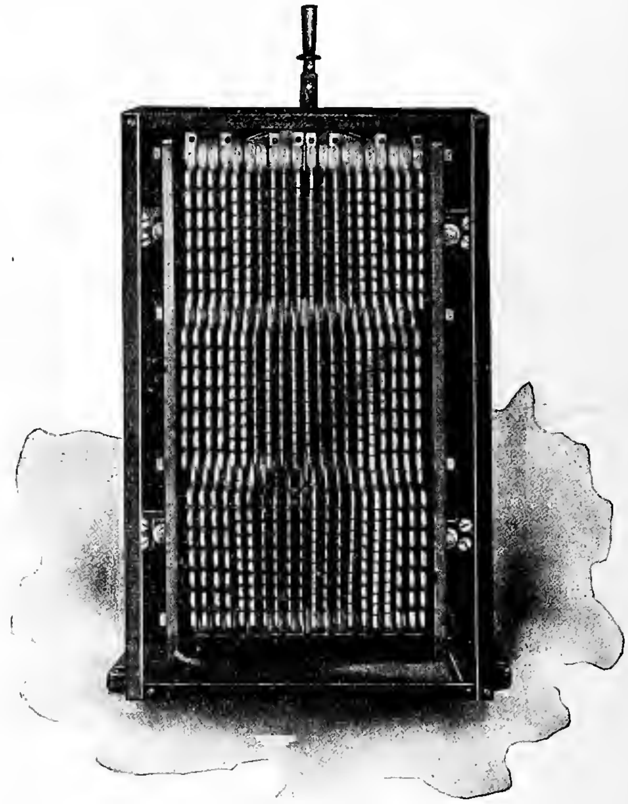
INDUSTRIAL

A NEW LINE OF CONTROLLERS.

The Electric Controller & Supply Co., of Cleveland, O., are placing upon the market a new line of controllers termed type G, which have a rating of 1 to 50 horsepower. These controllers were built to meet the requirements of general crane service where the conditions are not sever enough to demand the use of the Dinkey Ventilated Controller. The Type G-3 and G-4 Controllers are built with coil resistance and the Type G-5 and G-6 Controllers are built with cast grid resistance. When it is desired to place controllers above or in the rear of the operator the Type G Controller is furnished arranged for under lever operation. They are also furnished with spring return for operation from the floor by means of pendent ropes or chains. A number of crane users have decided that a 15 or 20 ton crane requiring a 25 or 30 horse power motor on the hoist and bridge motion may be operated from the floor by any of the men in the shop, thus saving the wages of a crane operator who would probably be idle half his time. It is a very simple matter to put cut outs at either end of the trolley travel and at either end of the run way to prevent accident. The Type G Controller meets this demand

TYPE G-5-CONTROLLER, FRONT VIEW.

for a controller up to 50 horse power arranged for operation from the floor by means of ropes. This controller is a self-contained unit, the resistance being placed in the frame, making it necessary to run only four wires between the controller and motor. Reversal is accomplished by the use of a single lever, no separate reverse switch being required. The Type G Controllers are self-contained, compact, and excessible. All parts are made to jig and are interchangable. The contact face is of heavy slate free from metallic veins. The contact segments are of copper which are screwed to brass lugs to which all wiring connections are made. By this construction any of the contact segments can be removed and replaced without disturbing the wiring connections. The contact arm is of soft cast iron and carries the fingers and finger holders, the insulation of which is of heavy pressed valcabuston bushings. The contact fingers are of dropped forge copper of great hardness and may be removed and replaced without removing the contact arm. A powerful and effective blow-out is provided in all sizes of these controllers. The frame for Type G-3 and G-5 Controllers consists of a main



TYPE G-5-CONTROLLER, REAR VIEW, CASE OFF, SHOWING RESISTANCE CONNECTIONS.

casting in one piece provided with a cover, the removal of which affords easy access to all resistance connections. The case enclosing this frame is of perforated steel, thus allowing ample ventilation. The frame of the G-4 and G-6 Controllers consists of a bottom casting which supports the resistance, and a top casting which supports the contact slate and arm. The top and bottom casting are connected by means of four steel corner posts around which a casing of perforated steel is provided for ventilation and protection to resistance. The top casting of the G-4 and G-6 Controllers supports the contract slate which is completely covered and protected by a sheet steel casing. This protects the operator from coming in contact with any live parts of the controller, and also protects the working parts of the controller from dust and dirt. Easy operation is secured by a lever which is keyed to the arm shaft at the back of the top casting, which gives a short movement of about 10 inches in either direction for both starting and reversing. The resistance for the G-5 Controller is built of cast grids in a single bank which may easily be removed as a unit without disturbing the other parts or moving the controller. The resistance for the G-6 Controller is made of two banks supported on bars attached to the frame, and may be removed in separate units without disturbing the other parts. The resistance for the G-3 and G-4 Controllers is made up of Type E coils which consist of a heavy asbestos tube stiffened by means of a central brass tube which serves to bring the rear terminal forward, facilitating the necessary connections. These controllers are very adaptable for service up to 500 volts. Six points of control are provided with the G-3 and G-5 Controllers, and eight points of control with the G-4 and G-6 Controllers.

WESTINGHOUSE SMALL POWER MOTORS OPERATING BEER PUMPS.

In the industrial and commercial field there are numerous operations requiring small amounts of power which have usually been laboriously performed by hand, owing to the lack of some convenient and inexpensive driving mechanism. With the growth of the electrical industry and its extension into new lines of work more attention has been given to the development and perfection of small power motors. In hotels, saloons and breweries, there are many applications such as bottle cleaners, automatic air compressors, beer pumps, etc. In Fig. 1 a Westinghouse ⅛-horsepower small power motor for alternating current circuits is shown driving a type "A" single-cylinder beer pump, for hotel and saloon use, manufactured by the E. R. Brown Beer Pump Company, of Boston, Mass. A Brown type "B" single-cylinder beer pump driven by a similar motor is illustrated in Fig. 2.

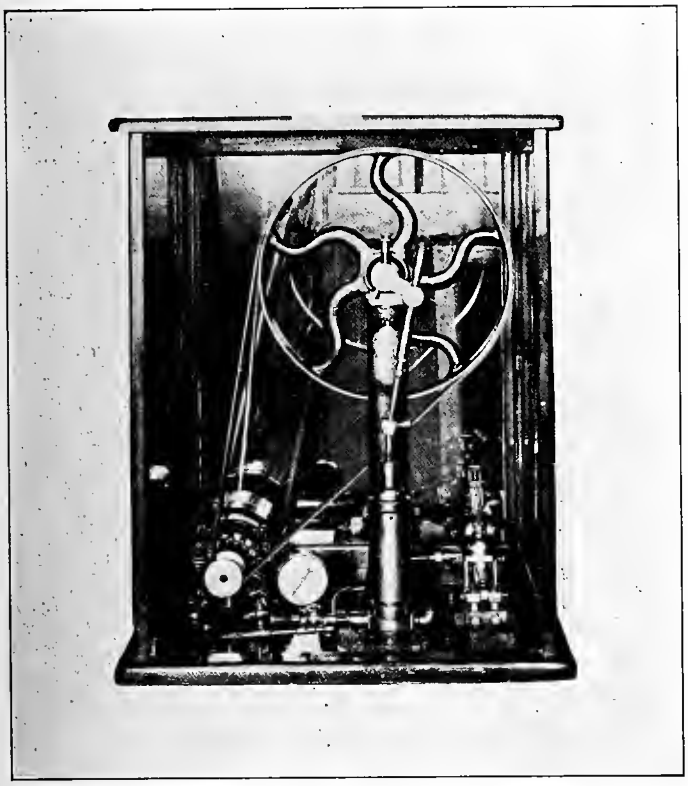


Fig. 1—Westinghouse Type "Da" A. C. Power Motor, ⅛ Horsepower, Driving Type "A" Beer Pump, Manufactured by the E. R. Brown Beer Pump Company, Boston, Mass.

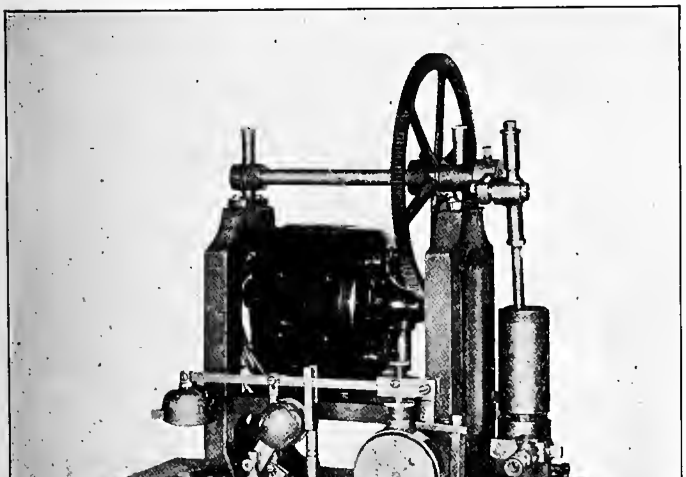


Fig. 2—Westinghouse Type "Da" A. C. Power Motor, ⅛ Horsepower, Driving Type "B" Beer Pump, Manufactured by the E. R. Brown Beer Pump Company, Boston, Mass.

These motors are compact, extremely neat in appearance, and thoroughly reliable in operation. They are built for both alternating and direct-current circuits, either 115 or 230 volts. The direct current motors are either shunt or series wound, and the alternating current motors are wound for 25, 60 or 133 cycles. The base of the motor consists of separate casting, the frame being drilled and tapped so that the feet may be fastened in any one of four positions, adapting them to use on floor, wall or ceiling.

EXTENDED TERMINAL ENCLOSED FUSES.

The Chase-Shawmut Company have just issued a folder describing their patented Extended Terminal Fuses.

Before the advent of National Electric Code Fuses, the manufacturers of enclosed fuses made a type "A," or screw-clamp contact fuse. In developing these fuses, the manufacturers, in many cases, made them up in different lengths for fuses of a given capacity. This fact has continually been a source of annoyance.

To obviate this, and to reduce and simplify the stock of type "A" fuses necessary for the user to have on hand, the Chase-Shawmut Company has developed and completed a line of fuses having a long or extended terminal on one end. This terminal is made of soft copper, and scored at different standard lengths. After once fitting the fuse to the base, the projections may be removed with pliers or hack-saw. This fuse will reduce the stock to one-third of the amount of fuses obliged to be carried before this Extended Terminal Fuse was developed.

CONVENTION OF ASBESTOS MEN.

Annual Meeting of the Sales-Staff of the H. W. Johns-Manville Co.

During the past week the various branch managers and department managers of the H. W. Johns-Manville Co. held their annual convention at the headquarters of the company, 100 Williams street, New York. This company has a world-wide reputation as being the largest manufacturers of asbestos, magnesia and electrical products in the United States, if not in the world, having factories at Brooklyn, Milwaukee, West Milwaukee and Hartford, Conn., and branch offices and warerooms in the following cities: Milwaukee, Chicago, Boston, Philadelphia, St. Louis, Pittsburg, Cleveland, San Francisco, Los Angeles, Seattle, Kansas City, Minneapolis, New Orleans, Dallas, and Buffalo. Representatives from the various branches and factories were present and the meeting was not only profitable but interesting to everyone present.

As a fitting finale, the convention wound up with a banquet at the Waldorf-Astoria, Friday evening, February 1st.

A LARGE PRODUCER GAS PLANT.

There is being erected at the works of the Simonds Canada Saw Company, Ltd., St. Remi, Montreal, the largest industrial producer-gas plant in Canada. It is of 600-b. horsepower capacity, and is to be used both for driving gas engines and providing gas for the various furnaces in the works. For almost a year Messrs. Simonds have had a 50-b. horsepower suction gas producer and engine operating part of their plant, and the great saving effected by its use has gone far in inducing them to make the present installation. The new plant consists of two independent producer units of 300-b. horsepower each, both having independent cooling and scrubbing apparatus, but discharging into one large gasholder of the gasworks type. After leaving the producers, which are of the Dowson type, the gas is first thoroughly cooled in a series of horizontal cast-iron coolers which have an exceptional radiating surface; it is then passed through a double water-sealed box of special design, thence through coke scrubbers of large capacity, and finally through dry purifiers. The gas is in this manner thoroughly cleansed of all tar, dust, and other impurities. The first of the large engines will be erected shortly, and will be a four-cycle single-cylinder horizontal unit of 150-b. horsepower.

This engine is of the special electric light type, having extended crank shaft with outer bearing and only one fly-wheel of extra large diameter, and weighing 10 tons. The crank-shaft bearings are of the continuous oiling type, similar bearings being also provided for the secondary shaft. The cylinder is provided with a removable liner, and all the valves are seated into loose boxes. The exhaust valve is fitted with the latest type of relief gear. A feature of the engine is its water cooling arrangements; independent water cooling is provided for the cylinder, piston, cylinder head, exhaust valve and exhaust valve seat. In this manner premature ignition due to over-heating of the parts named is eliminated. Ignition is effected by a powerful magnetic machine. The operator is provided with means of independently controlling the amount of air or gas, the time and intensity of the spark, and the engine speed. The engine is started quietly and easily by means of compressed air, one man only being required.

FILTERING PLANT IS OFFICIALLY OPENED.

John D. Spreckels, president of the Southern California Mountain Water Company, opened the valves of the new filter that has been constructed at Chollas Heights yesterday at 12 o'clock, and by this act was put into operation the largest and most modern filtering plant on the Pacific Coast. It is one of the only three such plants on the Coast, the other two being located at Berkeley and Oakland, but both of these are much inferior to the one just completed in San Diego. By the acquisition of this plant, San Diego will possess water that is unsurpassed by that of any city in the country for purity and healthfulness.

So mammoth is the filtering plant that Mr. Spreckels was occupied for fully fifteen minutes in turning the valves which released the water from the main pipes. The entire works were then placed in operation without a hitch of any kind. All of the great filters worked with the precision and thoroughness of clockwork.

The members of the company and others present when the valves were turned on by Mr. Spreckels were William Clayton, B. M. Warner, general superintendent of the company, Emory E. Smith, chemical engineer, and Mose Sisenvine, who was in charge of the construction of the plant.

The filtering plant has been in the course of construction for several months, and has cost about $100,000. The filter plant building covers an area of eighty feet by sixty-five feet, and there are ten filters, each twenty feet long and eight feet in diameter.

Emory E. Smith, of Smith, Emory & Co., of San Francisco, as chemical engineer for the company, had charge of the installation of the plant. Mose Sisenvine was the constructing contractor, and has been given high praise for the faultless work done on the plant, for, unlike most engineering feats of this proportion, there was not the slightest flaw found at the test made yesterday.

While the filtering plant has been put in operation, the water of the city reservoirs will not be affected for several days, as the flow has not yet passed from the filters into the reservoir. Only a limited supply of water was turned into the filters yesterday, for the purpose of washing out all sediment and to get the plant into good working order. It will probably be several days before this is completed, and then the by-pass gates will be opened and the undefiled water will pass into the great city reservoirs to be used in all parts of San Diego.

H. W. JOHNS-MANVILLE CO. IN BUFFALO.

The saying that "Nothing Succeeds Like Success" is well exemplified in the remarkable growth of the H. W. Johns-Manville Co. From a small beginning, half a century ago, this has become the largest concern in the world manufacturing asbestos, magnesia and electrical products, and the well-known reputation of the firm for producing nothing but the best is the factor which has contributed more than anything else to the company's success.

Within the past few months new branches have been opened at New Orleans, Dallas and Baltimore, so that the company now has sixteen branches throughout the United States, besides innumerable local representatives at various points. The business of the company in the city and vicinity of Buffalo has now reached such proportions that a new branch has just been opened at 214 Main street, Buffalo. This branch consists of a large retail store, offices and warerooms, and will be under the management of Mr. Geo. A. Schmidt, who for a number of years was connected with the Manville Covering Co., Milwaukee, which company is now a part of the H. W. Johns-Manville Co. Mr. Schmidt is well known throughout that section, having until recently been in charge of a special department of the W. A. Case & Sons Manufacturing Co., Buffalo, who until recently were the Buffalo agents of the H. W. Johns-Manville Co. Mr. M. F. Boscoe has been appointed assistant manager of this branch, and will make his headquarters in Rochester. Mr. Harry V. Patton, formerly manager for a local asbestos house, will also be associated with the new Buffalo branch.

NEW GENERAL MANAGER OF THE COEUR D'ALENE & SPOKANE RAILWAY.

Following the recent resignation of R. F. Blackwell as general manager of the Coeur d'Alene & Spokane Railway, comes the announcement made by Jay P. Graves, president of the Spokane & Inland Empire System, of the appointment to that position of Clyde M. Graves. Mr. Blackwell's resignation will not take effect until some time in March, when Mr. Graves will assume the management.

R. F. Blackwell was one of the original incorporators and builders of the Coeur d'Alene line and has been its general manager since its inception, three years ago. He leaves the road to devote his entire time to his lumber interests.

Mr. Graves will continue in his present position as general manager of the Spokane Traction Company after assuming the management of the Coeur d'Alene division next month.

STEAM PLANT IN FLOUR MILL.

The Tracy Engineering Company are installing one of their high economy steam power plants in the Sperry Flour Company's cereal mill at Stockton. Edge Moor water tube boilers, Nordberg compound condensing engine, and Tracy economy devices will be used. The Sperry people now have several Tracy power plants in operation and are getting results that warrant them in using steam instead of electric power.

NEWS NOTES

ELECTRIC RAILWAYS.

Spokane and Inland Empire Railroad System.—Progress is being made at the company's million-dollar plant at Nine-Mile Bridge, where the waters of the Spokane River are being harnessed to furnish 12,000 horsepower for operating railway lines and furnishing light and power. William F. Zimmerman, representing the company, is consulting engineer, the designing and constructing engineers being Sanderson & Porter, and the work is being carried forward under the supervision of F. M. Sylvester, local manager. The development of power is being accomplished by diverting the river with a flow of 12,000 cubic feet the second, from its natural channel. The dam will be 75 feet at its base, and 225 feet in length, exclusive of the power house, 110 feet wide by 87 feet by 87 feet above the low water mark, forming part of the dam, which will create a head of water of 60 feet, also backing the water a distance of five miles, thus furnishing an immense storage, to carry large fluctuations of load. The plant is designed to accommodate from 5,000 horsepower units, two of which are being installed. The electric generators will be 3,750 kilowatts, three-phase, 2,200-volt, 60-cycle alternators. The plant will be in operation the coming year.

Spokane and Inland Empire Railroad System.—Storage batteries, costing more than $200,000, have been installed on the Coeur d'Alene and the Spokane and Inland lines, and in connection with these is the frequency changing station costing $300,000. The company buys its power from the Washington Water Power Company, on a basis of $20 the horsepower a year for 24 hours' service. To take care of the surplus energy occasioned by light loads on the lines the battery system is employed. The battery contains 275 cells, and through it the "peak" load is kept at the average level, making a saving of 30 per cent. At the frequency changing station, the current, which comes direct from the power company's feed wires, is raised by transformers to a voltage of 45,000 and made an alternating current. At the sub-stations, four of which will soon be in operation, the current is reduced to a voltage of 6,000 for operating trains. The current is reduced every 12 miles.

Spokane and Inland Empire Railway System.—President Jay P. Graves' application for a franchise to build a million-dollar subway on Main and Front avenue, to connect the freight terminal with the main passenger station, a distance of nearly a mile, has been granted by the City Council of Spokane, and it is given out that work will begin in a short time. The subway will be double tracked, 30 feet deep, built of concrete and stone. The franchise provides that it must be completed in five years, but Mr. Graves says it will be ready in half that time. The purpose is to afford rapid transit within the city limits. As the franchise permits the use of steam and electric lines it is not unlikely that the Chicago, Milwaukee and St. Paul, the North Coast and the Kettle Valley Railway lines will use it to gain entrance to the heart of the city.

Northwestern Gas & Electric Light Company.—Officers of the company, controlled by capitalists from Philadelphia, are searching for another source of power. Since coming into possession of plants at Walla Walla, Baker City, Pendleton, Milton, Weston, The Dalles, Salem, Eugene and other places in Oregon and Washington, it has reached the limit of its capacity. The falls in the Deschutes River in Oregon to generate power for plants in Western Oregon and Washington. Engineers who have examined the falls give the opinion that power for several times the present requirements of the plant can be generated there. The plant furnishes electric light and power for Walla Walla, Pendleton, Athena, Milton, and Weston. Since the Walla Walla street car system has been in operation the plant has been more heavily taxed than ever, and competition of the inter-urban line from Walla Walla to Milton and Freewater will exhaust its capacity.

Idaho Northern Railroad.—This company, building a railroad from Kingston to Murray and from Kingston to Coeur d'Alene, Ida., is planning to continue its line into Spokane. It is understood that practically all the right of way has been secured. The right of way from Kingston to Coeur d'Alene by way of Fourth of July Canyon and from Kingston to Wallace, the famous lead-silver mining camp, is also complete. The entrance to Spokane will be through Greenacres and by way of East Sprague avenue.

Columbia and Walla Walla Traction Company.—J. H. Morrow, manager, has received an offer of terminal and depot grounds and right of way from the people of Dayton, Wash., as an inducement to build the line over the original survey. He prefers that route. The plan of a connection with the Graves' lines was discussed by Mr. Morrow and Jay P. Graves at a conference in Spokane recently, with a view of giving the latter an outlet to the Columbia. This could be provided, as the Columbia and Walla Walla Traction Company's terminal is at Wallula.

Bellingham, Wash.—S. L. Shuffleton, constructing engineer, states construction of the local interurban electric railway to be built by Stone & Webster will be started within two months.

Seattle, Wash.—The Seattle Electric Co. will double-track their Georgetown line from the Grant-street bridge to Georgetown.

Spokane, Wash.—The Spokane & Inland Railway Co. has applied for franchises for two single track branches with switches and side tracks in alleys between Riverside and Main avenues.

Portland, Ore.—Plans have been completed for beginning work on the Front street line of the United Railways Co., L. B. Wickersham, chief engineer.

Seattle, Wash.—The Seattle Electric Co. and the Seattle, Renton & Southern will apply for a franchise on Letitia street, between Hudson street and the city limits.

Tacoma, Wash.—The Electric Logging Company has petitioned the county commissioners for a franchise to build a logging railroad at its camp on the Tacoma Eastern.

Tacoma, Wash.—Grading on the new Puyallup line of the Tacoma Railway & Power Co. is progressing rapidly.

OIL.

Grass Valley, Cal.—The fuel-oil shortage has reached alarming proportions. The representatives of the Associated Oil Co. here have been unable to get in a single barrel for over two weeks. Their reservoir, which supplies a number of the largest mines in the district, is empty, and only one tank car obtained is unknown, and the famine is causing grave apprehension among the mines affected. Already the Conin mine has been forced to suspend for lack of crude petroleum for its furnace, and the surface water is running down the shaft. The Pennsylvania and the Central Shaft also oil consumers. The Narrow Gauge line is also affected, but luckily it has but one oil-burning locomotive now in commission.

POWER AND LIGHT PLANTS.

Falls City, Ore.—Mr. Newson of Rainier, Ore., has applied to the council for a franchise for an electric light and power plant.

Portland, Ore.—The Oregon Gas Mfg. Co. has been incorporated by A. King Wilson, O. A. Neal and J. A. Arment. Capital, $100,000.

Tacoma, Wash.—City Electrician A. L. Thom plans to overhaul and reconstruct the lighting plant in the downtown district. Heavy copper mains will be strung in place of the lighter wires now in use and large transformers will be substituted for the smaller one. The cost will be over $50,000.

West Seattle, Wash.—The Seattle Electric Co. and the Seattle-Tacoma Power Co. will apply for lighting franchises.

Oroville—The Great Western Power Co. has completed preliminary operations at Big Bend, and active development work has begun. At present 300 men are at work, and the force is to be increased to 600. The old Big Bend tunnel is to be enlarged and lined with solid concrete masonry. It will have an inside measurement of 235 square feet. A new tunnel, 3,500 feet long, will be driven from the end of the old tunnel up the North Fork of the river. From the outlet of this tunnel the water will be carried to the power house in pipes. Present plans call for the development of 50,000 horsepower, and the total capacity of the plant will be 100,000 horsepower. The total fall of the water will be 535 feet. The company figures on a total expenditure of between $5,500,000 and $6,000,000.

Ely, Nev.—The power plant of the Ely Electric Light and Power Co. is nearly completed and within the next 30 days the town of Ely will be supplied with electric lights, and several of the hoists on the mines in this vicinity will also be operated with electrical power. The plant is to be one of the largest in the State and is the first to be built in this portion of Nevada. It will not only be used to light Ely and a number of small camps in this vicinity, and to operate the hoists and machinery in a number of the Ely mines, but the power will also be used in operating an electric car line between Ely and the smelter site several miles from Ely. A company has already been formed to build. The smelter site will be connected with Ely by a modern electric car line.

Red Bluff—The Pacific Power Co.'s operations on Battle Creek are being pushed. Men are at work clearing a site for the power plant, while others are building houses for themselves and families. Everything will soon be in readiness for the building of the first power plant. The second plant will be built on a much larger scale and will be commenced soon after the completion of plant number one.

Redding, Cal.—The Northern California Power Company is having plans made in San Francisco for a fine office building that will be erected in this city on the company's lots opposite the court house. The building will be constructed of concrete, with fancy brick trimmings, in the old Spanish style of architecture.

Spokane, Wash.—The Cheney Light & Power Co., capital $25,000, has been incorporated by H. L. Bleecker, Charles P. Lund and W. S. Gilbert.

Spokane, Wash.—The Spokane Gas Light Co. is planning to build a water gas plant at a cost of $65,000.

Twin Falls, Ida.—The Telluride Power Co. has applied for a franchise to supply the town with light and power.

Waverly, Wash.—The Waverly Water Works and Light Co. has been incorporated by Arthur D. Jones, J. P. Graves, F. Lewis Clarke and others. The company will erect a large plant for electric lighting and for their water works plant at a cost of $50,000.

TELEPHONE AND TELEGRAPH.

Asotin, Wash.—F. B. Simpson, who has had supervision of the Asotin Tel. Co., has sold his interest to J. N. Cunningham of Clarkston for $3,500.

Asotin, Wash.—A Farmers' Tel. Co. has been organized by C. E. Zimmerman, Walter Sangster and W. F. Hurst.

Bellingham, Wash.—F. D. Fobes, Dr. Graffin and H. J. organized by Henry Richardson, N. C. Davenport, Enos Strode and J. H. Oltmanns. The company has applied to the county commissioners for a franchise to construct a line from the city limits along the Guide Meridian road to Laurel and thence to Ferndale.

Belingham, Wash.—F. D. Fobes, Dr. Graffin and H. J. Strickfaden have secured a franchise to build a telephone line between this city and Maple Falls.

Bellingham, Wash.—The Ten Mile Tel. Co. was organized at Ten Mile by J. C. Miller, representing the Sunset Tel. Co. The officers are J. N. Nygran, president; Furman D. White, secretary, and N. Jordal, treasurer. The line will run from the Ten Mile school house to the Guide Meridian road and follow that highway to this city.

Dillon, Mont.—The Dell Tel. Co. has been organized with a capital of $10,000. Frank A. Hazelbaker, secretary and general manager. The company will build a line from Dell to Sheep Creek Basin and other parts of the county.

Fernie, B. C.—The Revelstone Trail & Front Lake Tel. Co. will build a long distance line to Elkmouth and Hosmer.

Big Harbor, Wash.—A committee composed of A. E. Johnston, M. V. Iliff, and W. H. Rust was appointed to confer with telephone companies in Tacoma with a view to establishing a line from Tacoma to this place.

Grangeville, Ida.—C. McDaniels, manager of the Buffalo Hump Tel. Co., is building a telephone line from Concord to Oro Grande.

Kelso, Wash.—Under the direction of J. D. Eaton a crew is now at work here mapping out the route for the new line of the Northwestern Long Distance Tel. Co.

Port Townsend, Wash.—The Independent Tel. Co. has completed the construction of a line between this place and Port Ludlow, and work is now under way for construction of a line to Seattle.

Sheridan, Ore.—The Sheridan Independent Tel. Co. has been incorporated by Charles W. Buell, J. K. Gutry, and R. V. Stockton; capital, $4,000.

Warren, Ida.—Mr. Friar states that arrangements have been completed for the construction of a telephone line from Ramey ridge to this place. John T. McCoy is president of the company.

Sherwood, Ore.—The Sherwood Mutual Tel. Co. has been incorporated by J. P. Young, L. S. McConnell and Fred Langer.

Crockett, Cal.—It is learned that the Pacific Telephone & Telegraph Company is gathering data and forming plans to improve the system. These plans provide for the locating at Crockett of a central station, for the territory between Port Costa and Tormey. Information says a great change in service along water front will be made.

Phoenix, Ariz.—E. L. Bumpus, Arizona manager for the Pacific Wireless Telegraph Company, states that the company will have stations in Phoenix, Tucson, Bisbee and Prescott within a year. The company owns its own manufacturing plants.

New York, N. Y.—An increase of ten per cent. in the salaries of telegraph operators at the company's principal offices throughout the country was conceded by the Western Union Telegraph Company recently.

WATER WORKS.

San Francisco, Cal.—The Board of Supervisors has begun its investigation of the properties and general finances of the Spring Valley Water Co. for the purpose of establishing a basis upon which to determine and to fix the water rates to be charged to the city during the fiscal year beginning July 1, 1907. Little progress was made, owing to the fact that the Board had not received the report of City Engineer T. P. Woodward, appraising the Spring Valley's properties, and that the company was not able to furnish its own inventory of properties, which, it was announced by its representatives, it would not be able to furnish before next Wednesday. According to Woodward's report, he places the value of the whole peninsula system of the Spring Valley at $9,743,749; of the Alameda Creek system at $5,265,010; of the city distributing system at $6,654,590; of miscellaneous properties at $200,500—making a grand total valuation by the City Engineer of $24,569,828, which allows for damage and for betterments made last year.

San Francisco, Cal.—The election of Capt. A. H. Payson to succeed E. E. Calvin in the presidency of the newly organized Northwestern Pacific Railroad, was followed by the announcement that the former will retire shortly from the presidency of the Spring Valley Water Co.

Los Angeles, Cal.—The Western Gas Engine Co. of Los Angeles has secured the contract for installing and furnishing a pumping plant near the northern limit of the grounds of the Soldiers' Home. The price is $1,200. Another contract was let to Charles Parcels of Sawtelle for the sinking of a 12-inch well for the development of water. The location is about a half of a mile east of the powerhouse. The contract price is $950.

Capitan, N. M.—The Alamogordo Improvement Co. has sold its interests at the new division point, Carrizozo, to a new company of California people, with I. O. Wetmore as trustee. Considerable money will be spent on parks, buildings, streets, etc. Another company has been formed to pipe water from the mountains to the new town.

ILLUMINATION.

Healdsburg, Cal.—Representatives of G. W. Wickersham of San Francisco have appeared before the board of trustees and asked for the privilege of installing a gas plant in the city of Healdsburg for heating and cooking purposes.

San Francisco, Cal.—In order to secure the improvement of Fillmore street and to enable the city to begin work of repaving and installing a new lighting system of that street without further delay, the members of the Fillmore Street Improvement Association have subscribed to nearly $50,000 worth of city bonds.

Los Angeles, Cal.—The city council has opened bids for steel poles, pole steps and bolts, cedar poles, cross-arms and wire, and awarded contract to B. F. Kierulf, Jr., & Co., of Los Angeles, as follows: Steel poles, pole steps and bolts, $3,250; cedar poles, $10,975; cross-arms, $1,275; wire, $19,431.84.

Eureka, Cal.—Contracts have been awarded by the board of directors of the Eureka Lighting Company to Langford Bros., local contractors, for the erection of a new gas plant at the foot of Whipple street, to cost in the neighborhood of $40,000, and Superintendent T. D. Perch of the same company is in San Francisco, where he will make arrangements for the purchase of new machinery and equipments for the gas plant.

Anaheim, Cal.—Sealed proposals are being received by the board of trustees, at the office of the city clerk, for furnishing the city forty series alternating current enclosed arc lamps, with base enclosing globes of opalescent glass; to have black japanned body; lamps to be rated 5.6 amperes and to use ½x12-inch carbons. Plans are now one file with the clerk.

Anaheim, Cal.—Sealed proposals for the construction of a Municipal Light and Water Works building are being received by the board of trustees in accordance with plans on file with the clerk and in the office of Copeland and Seganck, mechanical engineers, National Bank building, Los Angeles.

Mill Valley, Cal.—The San Rafael Gas & Electric Co. has completed arrangements to install an auxiliary substation at Alta for the benefit of Mill Valley and Sausalito. A contract has been entered into with the North Shore Railroad by which the electric company secures a portion of the railroad's power house at that point for its new substation.

The JOURNAL OF ELECTRICITY
POWER AND GAS
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The Engineers', Architects' and Builders' News

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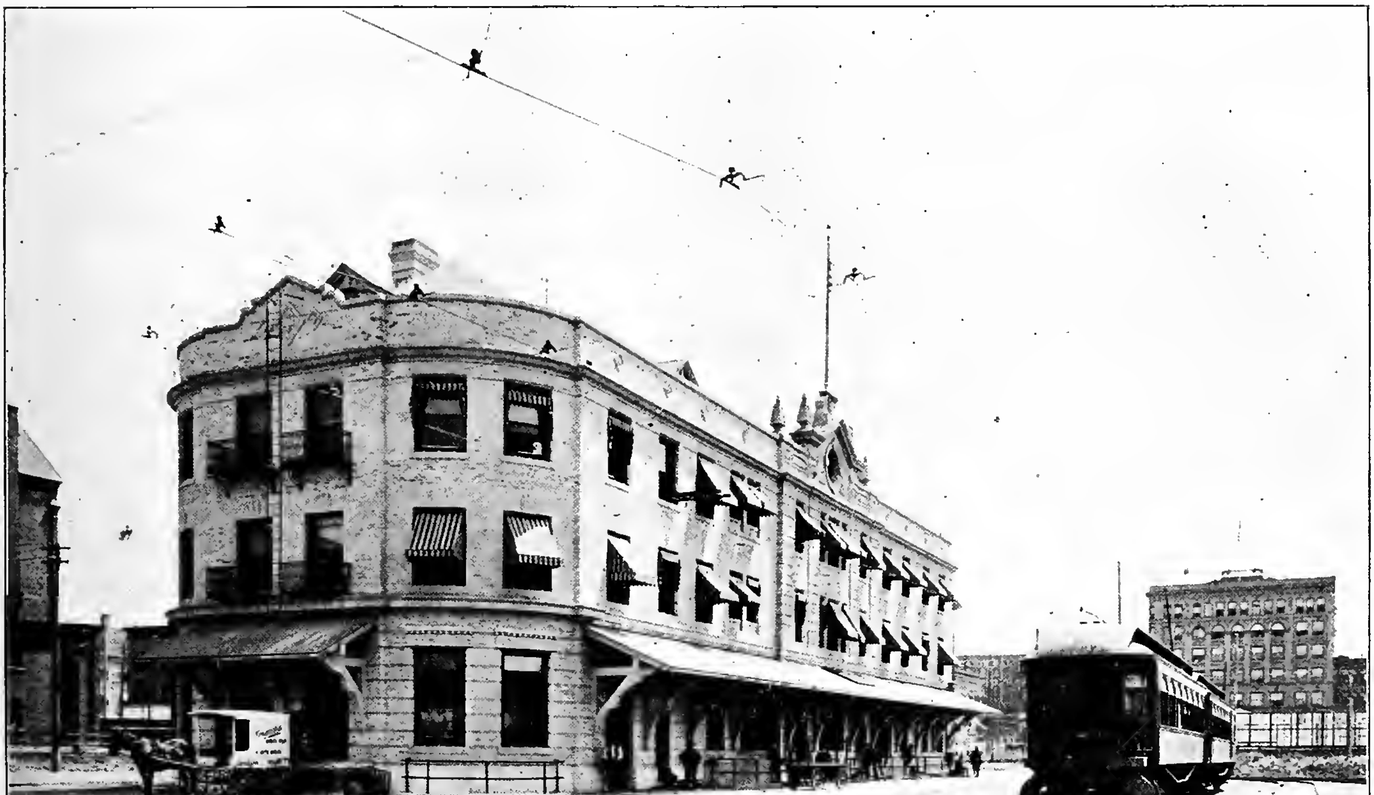
The Engineers' Architects' and Builders' News

VOLUME XVIII. SAN FRANCISCO, CAL., MARCH 9, 1907 No. 10

Electricity Replacing Steam on Railways of Pacific Coast.

The electrification of steam railways is not confined to the eastern states, or to the countries of Europe. On the Pacific Coast electric power is being utilized, not only for street railway systems, but also railway lines which formerly were operated by steam, and others under construction which under normal conditions of the past decade, would be states, the Inland Empire Electric Railway system of the State of Washington. The illustrations also indicate the construction and arrangement of the electrical apparatus of the sub-stations and the frequency changing stations employed for supplying current to this electrified system.

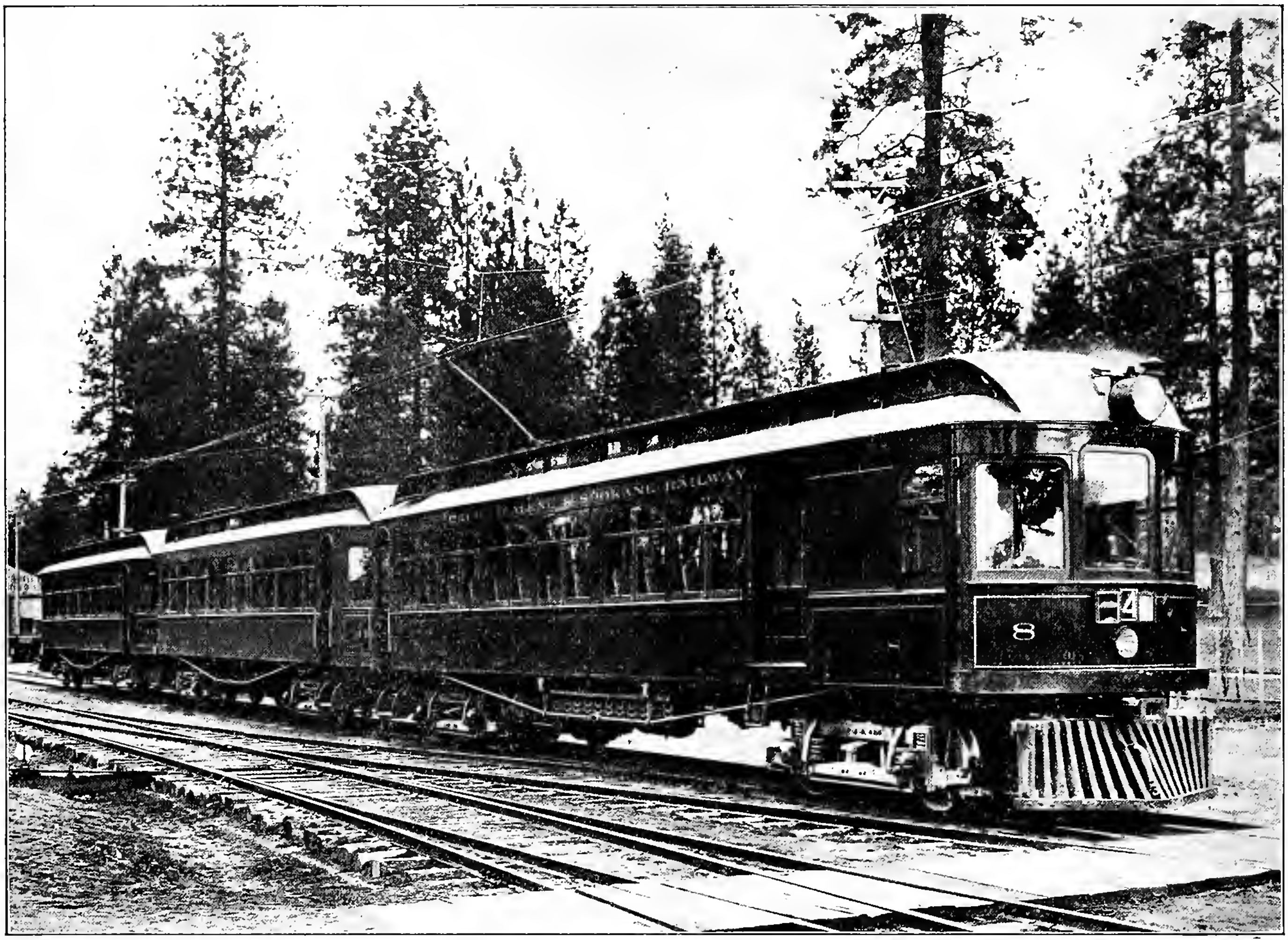


Spokane Electric Terminal at Main Avenue and Lincoln Street. The building is 30x160, and is used as a terminal by the Coeur d'Alene & Spokane Electric Railway and the Spokane & Inland Electric Railway. The executive offices of the Inland Empire System are located in this building, and the several offices of the Coeur d'Alene & Spokane Electric Road, Spokane & Inland and the Spokane Traction Co., all subsidiary companies of the Inland Empire System. The building cost $110,000, and is finished in golden oak with native marble trimmings.

equipped with steam locomotives, now are provided with electric freight engines, and the trains for passenger service are electrically equipped.

The accompanying illustrations show the line, stations and passenger, as well as freight trains and locomotives of one of the most interesting railway systems in the western

The Spokane and Inland Empire Railroad Co. was organized in the State of Washington, to construct and operate electric properties, owning two valuable power sites on the Spokane River, and also a franchise for the distribution of electricity.



The "Shoshone Flyer," which leaves Spokane Electric Terminal every morning in the year at 8 o'clock over the Coeur d'Alene & Spokane Electric Railway for Coeur d'Alene City, Idaho, where the Red Collar steamer is taken for Harrison, at which point connection is made with the O., R. & N. for Wallace, Wardner and points in the Coeur d'Alene mining country. This train makes the run to Coeur d'Alene—a distance of thirty-four miles—in one hour.

It has also acquired the Spokane Traction Co., which is an electric street railway system operating in the City of Spokane. The Spokane Terminal Co. is included in the same system, owning freight yards, passenger and freight terminals, as well as rights of way in Spokane.

The Inland Empire System also has acquired the holdings of the Coeur d'Alene and Spokane Railway Co., Ltd., and electric railway operating between Spokane, Washington, and Coeur d'Alene and Hayden Lake, Idaho, as well as the Spokane & Inland Railway Co., building an electric railway between Spokane and Colfax, Washington, and the City of Moscow, Idaho.

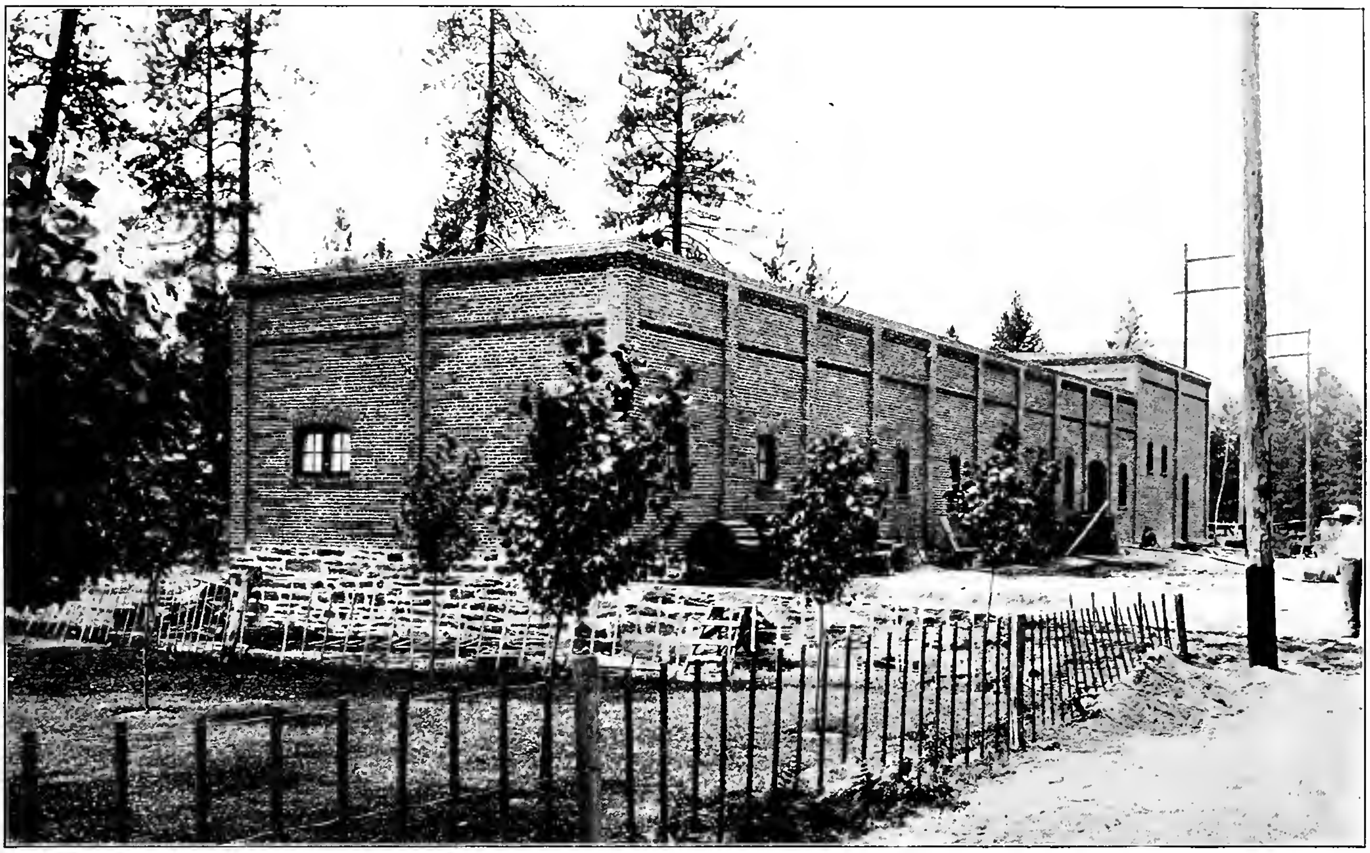
Freight terminal used by the Inland Empire System. The building is 40x300 feet. The present freight terminal grounds are 300x2,000, and are located directly between the Great Northern yards on the north and the Northern Pacific yards on the south, and connected with both by transfer track.

An electric power development of from 20,000 horsepower to 30,000 horsepower is owned by this Inland Empire System, the two power sites being on the Spokane River, one at Nine Mile Bridge now being developed and the other the "Bowl and Pitcher," at the city limits.

The Nine Mile Bridge power plant has a capacity of 12,000 horsepower, and it is stated that the location is ideal on account of the canyon's narrowness and rocky formation at this point. There is a lake made by the dam which is useful for regulating the flow of water, this lake being about five miles in length.

Until this power development is completed electric power is being obtained from local power circuits under a ten years' contract, this electric power to be used as auxiliary to the main power stations, when they are in complete operation. The price paid for electric power is $20 per horsepower per year for 24-hour service.

The frequency changing station shown in the accompanying illustrations supplies current to the Spokane & Inland Railway and the other lines, and is located at Spokane, on the former line. The booster sets in this sub-station are used in connection with the storage battery plant and the direct-current machines. These motor generators, the motor-driven exciter sets and main motor generator sets, together with the switchboard equipment, was designed, constructed and installed by the General Electric Company, of Schenec-



One of the sub-stations used on the Coeur d'Alene & Spokane Electric Railway. This station contains 400 and 200 kilowatt rotary converters; also storage batteries to control peak loads and operate line in case of trouble with alternating current system.

tady, and the Westinghouse Electric & Mfg. Co., of Pittsburg, Pa.

There are four main motor-generator sets in this station with three machines mounted on the same base. These sets include a direct-current shunt-wound generator utilized in connection with the storage battery to take off peak loads, the same as in standard direct-current practice.

The 60,000-volt, high-tension oil switches are located in the gallery, the main switchboard being used in operating the four 1,000-kilowatt motor-generator sets seen in the frequency changing station.

Electric locomotives used for freight hauling on the Spokane & Inland division of the Inland Empire System. For long and heavy hauling these locomotives are used in pairs. Each unit has 600 horsepower and weighs 50 tons. With direct current, on the Coeur d'Alene & Spokane Electric Railway, one of these units hauls 1,080 tons with ease up a 1 per cent. grade. On the Spokane & Inland division, with alternating current, one unit will handle 315 tons on a 2 per cent. grade. The Inland Empire System has six of these locomotives for use on the Spokane & Inland Railway.

There are panels also on the main switchboard with apparatus for handling the storage battery current in connection with the direct-current machines to control the peak loads.

In the rotary transformer sub-stations used on the Coeur d'Alene & Spokane Electric Railway there are also storage battery plants for regulation purposes and also for controlling the peak loads, and employed also in emergencies in case of accident or trouble on the alternating-current system. In these sub-stations the rotary converters employed are of 200 kilowatts and 400 kilowatts capacity, the usual electric railway practice being employed in connection with these installations.

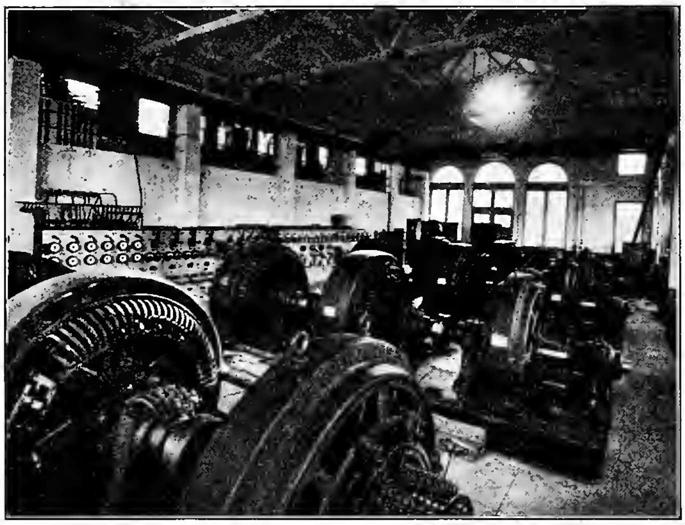
The current is conducted along the lines by overhead feeders and tapped in to the overhead trolley wires in the usual manner, in the case of the passenger trains ordinary trolley poles being used for taking the current from the trolley conductors, and with the freight locomotives special collecting devices being employed in addition to the usual trolley pole, which is also provided on these electric locomotives.

The electric locomotives used for freight hauling on the Inland Empire system are shown in the accompanying illustration, two being used in pairs for long and heavy trains. Each of these electric freight locomotives weighs 50 tons and develops 600 horsepower. It is maintained that on the Coeur d'Alene & Spokane Electric Railway, one of these units hauls 1,080 tons with ease up a one per cent grade, utilizing direct current. On the Spokane & Inland division, with alternating current, it is stated that one unit will handle 315 tons on a two per cent grade. There are six of these high-power electric locomotives for use on the Spokane & Inland Railway.

This portion of the Inland Empire System extends in a southerly direction from Spokane to Spring Valley Junction, where the road branches, the western division extending into Rosalia and Colfax, and the eastern division to

Oakesdale, Garfield and Palouse. The road, when completed, will have a total mileage of 113 miles, the eastern division being extended from Palouse to Moscow, Latah County, Idaho.

The freight terminal used by the Inland Empire System includes a building 300 feet long and 40 feet wide, the terminal yard being 300 feet wide and 2,000 feet long and connected by transfer tracks with the Great Northern yards on the north and the Northern Pacific yards on the south.



General view of frequency changing station used by the Spokane & Inland Railway in Spokane, showing motor generator sets with direct current shunt wound machine used in connection with storage battery to take off peak loads, same as in standard direct current practice; also showing 60,000 volt high tension oil switches in gallery to the left.

The accompanying illustration shows the "Shoshone Flyer," carrying passengers to Coeur d'Alene, a distance of 34 miles, in less than one hour, every morning. The Red Collar steamer leaves from this point for Harrison, where many make connection for the Coeur d'Alene mining country. The Spokane Electric Terminal is located at Lincoln Street and Main Avenue, and is used by all of the lines of the Inland system. The building cost between $100,000 and $200,000, and is 160 feet long and 60 feet wide, finished in golden oak with native marble trimmings.

Spokane has a population of 85,000 with real estate worth $15,000,000 transferred in one year and $13,000,000 expended in buildings in the last six years. There are great opportunities for these electric lines, it is claimed. On Coeur d'Alene the annual cut of timber is 30,000,000 feet and 100,000,000 feet on the St. Joe and St. Maries Rivers.

FACTS PERTAINING TO AIR COMPRESSORS.

If air at atmospheric pressure and 60 degrees F. could be compressed to 100 pounds gauge-pressure, and all the heat due to the work of compression taken away as fast as generated, so that the temperature during compression would remain constant, the mean effective pressure during one stroke of the air piston would be 30.2 pounds. If, on the other extreme, none of the heat due to the work of compression is taken away, the mean effective pressure during the stroke will be 41.6 pounds, and the terminal temperature will reach 485 degrees F. As the power required for compression is directly proportional to the mean effective pressure, it will be seen that the additional power required in the latter case is 37½ per cent of that in the former. In practice neither extreme can be reached, for it is impossible to completely cool the air during compression, and, on the other hand, some of the heat of compression will be radiated; but the lower extreme is the ideal, and the nearer it can be approached the more economical will be the work done.

TRACTION ECONOMICS.

Lecture Delivered by Mr. Elbert G. Allen to Students in Electrical Engineering, University of Washington, January 16, 1907.

The commercial problem is always one of dollars and cents. An electric railway has its quasi public functions wherein it should make every effort to warrant the confidence of the public intrusted to it in the granting of its franchise. Nevertheless, the fact must always be borne in mind by the engineer that in order that the public may reap the full benefit to be obtained in the way of cheap transportation the economics of the corporation are a matter of public concern. Moreover, while the corporation is a servant of the people the engineer is a servant of the corporation which has made the existence of the public utilities possible. It is consequently a matter of interest to the engineer to know something of the manner in which money is raised and handled for the construction and operation of the plant.

An electric railway may be owned by an individual or by a number of people, generally the latter. In such a case a stock company is usually organized and certificates of stock issued as evidence of the proportionate ownership of the holder. It is these stockholders who have taken the initiative and the risk to whom the legitimate profits of the business belong. The amount of money to be raised is generally so large that it is advisable to borrow a part, mortgaging the property to secure the loan. This loan constitutes the bonded indebtedness of the company. As a company is never bonded to a greater extent than is fully covered by the actual value of the property, the risk assumed by the bond holders is small, and the interest correspondingly reasonable. Practically all risk of failure of the proposition or loss through depreciation or other causes is assumed by the stockholders, and it should be the aim of the management to return to the stockholders as large a dividend as is reasonable in return for their risks.

The expenditures of a company are broadly divided into two classes: First, those which add to the value of the plant, and, second, those which are for the operation of the plant or for maintaining it in first class shape. Expenditures for increasing the value of the plant are rightfully paid for from any funds resulting from the sale of stock or bonds. Any new line, a new side track or feeder, is just as much a part of the capital expenditure as is the originally constructed road. It is expected, however, that the plant will maintain itself in as good condition as new and the replacing of worn-out apparatus and the current repairs add nothing to the value of the property, and, consequently, must be paid for out of the earnings of the road.

Next to the payment of actual operating expenses and maintenance charges the fixed charges must be taken care of. These consist of such things as interest on the bonded indebtedness. Failure to meet such obligations results in the foreclosure of the mortgage and the passing of the property into a receiver's hands. For any company to remain self-sustaining, its revenue must be sufficient to pay its current expenses, maintaining its plant in good condition, and also its fixed charges. From the surplus remaining after paying these things, the directors may at their discretion reserve funds to take care of the depreciation, which must take place in all machinery in spite of the best of care, for replacing obsolete apparatus and any other so-called sinking funds. Any funds remaining may be paid to the stockholders from time to time as dividends.

The question of proper sinking funds is one which is peculiar to the situation. In all plants there are certain kinds of depreciation which cannot be avoided. For example, in the present state of the art of electrical apparatus rapidly

becomes obsolete, and if a plant is to maintain itself as an up-to-date system, it must from time to time replace such apparatus with more modern types. Sinking funds are often reserved for this purpose.

Calculations to determine the most economical kind of construction, amount of material, etc., almost always involve both factors of expense—operating expenses and fixed charges. The kind of construction which costs most to install, and hence adds most to the fixed charge account, is usually the cheapest to operate and vice versa.

To take a very simple case, let us calculate the most economical amount of feeder costing $1.00 per million c. m. feet, erected for a 10,000-foot car line using 1,000 amperes with power worth $30 per kilowatt year, allowing 10 per cent fixed charge on the feeder. Figuring on a theoretically uniformly tapering conductor and a uniformly distributed load, we find that letting X equal the number of million c. m. feet of copper used,

$$\text{Voltage drop} = \frac{10.5\ A\ L}{cm} \qquad \text{Where } A = \text{total amperes}$$

$$L = \text{length in feet}$$

$$cm = 1/2\ cm \times L \qquad cm = \text{area at station end.}$$

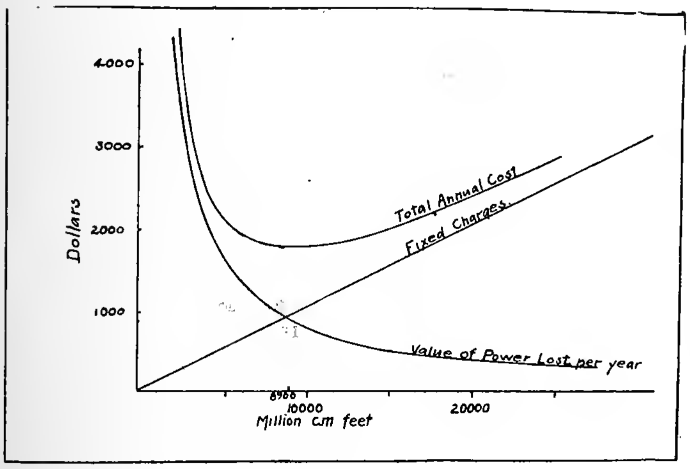
$$Z = \text{total cm feet.}$$

$$\text{Watt loss} = 1/2\ AV - \frac{10.5\ A^2\ L^2}{4\ \ Z}$$

Substituting values,

$$\text{Value of power lost} = \frac{7{,}875{,}000}{X} \text{ dollars per year}$$

$$\text{Fixed charges,} = 0.1X \text{ dollars per year.}$$

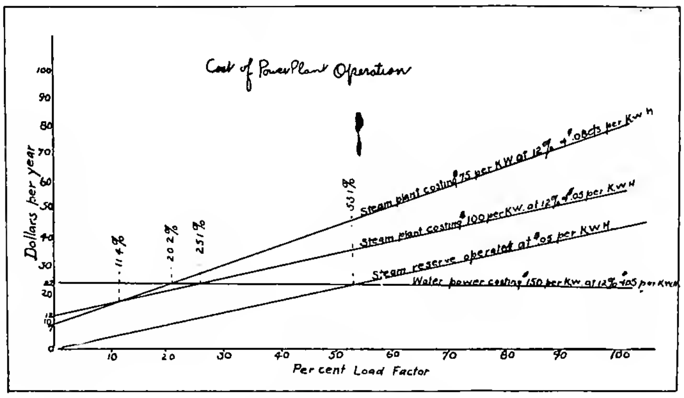


These curves are shown graphically, and their sum, representing the total annual cost, shows a minimum at about 8,900 million c. m. feet. From this we see that for the conditions assumed the most economical feeder would start with 1,780,000 c. m. at the station.

In comparing the costs of operating different types of plants a diagram similar to figure 2 is frequently convenient. In this diagram the costs of operation are shown as functions of the load factor on the station. The costs are separated into the fixed charges which are a certain percentage of the investment, and the operating costs which are nearly proportional to the output with steam plants and vary approximately with the size of plant for water powers. Thus, with the figures assumed it is seen that for loads which occur but 11.4 per cent of the year or less, the cheapest operation is from a steam plant cheaply installed in spite of its larger operating cost. For loads with load factors of from 11.4 per cent to 25.1 per cent the more elaborate but economical steam plant is the cheapest, while for the base load the water power has the advantage. If, however, a reserve steam plant is maintained, it would be cheaper to operate it on all loads with a load factor of 53.1 per cent or less, rather than install additional water powers.

Fig. 2.

Cost of Power Plant Operation.

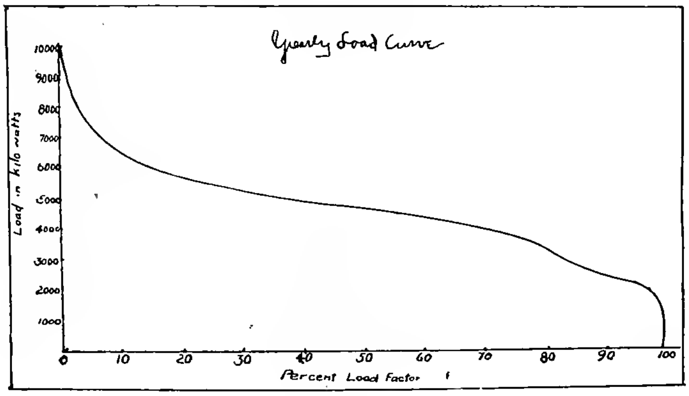


Per Cent Load Factor.

In using this chart, another similar to Fig. 3 is convenient. This gives the load factor of any given load. For example, in the instance given a load of 5,000 kilowatts was carried 40 per cent of the time during the year. Comparing the two charts it is seen that about 5,500 kilowatts could be economically carried on water power, 1,000 kilowatts on a high-grade steam plant and the remaining 3,500 kilowatts on a cheap steam plant.

Fig. 3.

Yearly Load Curve.



BIG FIND OF ANTHRACITE.

The United States Consul at Riga reports that large deposits of anthracite coal have been discovered in the Russian territory of the Orenburg Cossacks. The depth is only 56 inches, and the vein extends about 133 miles north to south, and at about the same distance in a southerly direction from the Great Siberian Railway. The great value of this discovery, it is stated, lies in the proximity of the coal fields to the Ural iron and steel industry, which is at present mainly dependent upon wood and charcoal for fuel, and therefore otherwise incapable of a further expansion. In view of the probable early exhaustion of the South Russian iron-ore mines, estimated to take place in abouty twenty to thirty years, the Ural district is destined to become the largest producer of iron and steel in the Russian Empire. In the neighborhood of the coal fields, deposits of brown hematite have been found.

REHABILITATION OF CUSTOMERS' PIPING.*

No doubt you have all noticed from time to time that gas properties are being purchased throughout the country, and that in almost every case the new owners are called on to spend a vast amount of money in rehabilitating the works, mains, services, meters, etc. This apparently is as far as anyone goes to put their own properties in good shape and earn more money for them. I have often wondered why the subject was not gone into a little further, and the pipes and appliances of the customer rehabilitated and put in good working order for the consumption of gas, and why this was not included in the general plan of rehabilitating the property so purchased.

Take any good-sized town that has been in existence for, say, fifty years. There is no question but that some of the customers' piping is entirely too small to serve the gas appliances which they now have, and if any more appliances should be added to their piping they would not get satisfactory results, neither would the gas company get satisfactory revenue.

And, again, for years past gas companies have been running pipes for appliances, but I have never heard of a case where a gas company made a first installation that they ever ran any pipe larger than required by the appliances installed.

It has been common practice to go into a man's premises who is just commencing to use gas, and if his first purchase is that of a range, if the distance is not too great, to run ¾-inch pipe from the meter to the range. Then if a water heater were subsequently purchased the heater would be connected to this first piping; and if a laundry stove or other appliances were purchased, they would also attach them to this piping. In this way the original pipe which was installed is made to become the fuel system, and, of course, becomes too small to serve the purpose for which it was installed.

Then, again, in the fitting work which has been done in the past, quite a number of pipes were trapped. These the gas company takes care of in the winter by blowing them out, but makes no effort to remove the source of trouble. Summer time comes again and they forget all about it until the following winter.

A systematic inspection of piping and fittings in almost any town will show that somebody will have to go to considerable expense in rehabilitating customers' piping. At the time the majority of the buildings were piped, no attention was paid to sizes, to allow appliances to be introduced later for the use of gas, and even gas companies in years past have done considerable poor work themselves along the same lines. To remedy this trouble in the future and provide means for the customer to get all the gas he wants, and at the time he wants it, a set of rules and regulations for running piping for fuel is herewith submitted.

All new buildings should be equipped in accordance with same, and all pipe work run by the gas company should also be run according to these rules. These rules are based on the class of buildings the pipes are to be placed in. A residence that has a laundry, kitchen and three or four fireplaces should be figured about as follows: Each laundry to be counted as one opening; each kitchen to be counted as three openings; each fireplace to be counted as one opening.

At the time the building is built, pipe should be run to supply fuel appliances at each of these locations. If appliances are not to be installed at the time building is piped the fitter should be permitted to run the pipes to these locations and cap up. If in an old building the gas company receives an order to place a gas range, the necessary fuel pipe of the proper size should be run in the basement to supply all the appliances that may be used in the building at any time.

*A paper read by Mr. John C. D. Clark, of St. Louis, Mo., before the National Commercial Gas Association.

In making the run through the basement, plug openings should be left in the fuel line opposite such fireplaces and other locations where fuel appliances are to be used. While, of course, in the start, this will cost the gas companies a trifle more for pipe, and a slight increase in labor, it will always leave them a fuel system in each of their customers' houses that will take care of any additional appliances that may be installed later.

In cases where Ruud or Monarch water heaters, or appliances of similar character, are to be installed, a separate exposed run should be run direct from the meter to the location of the appliance. When exposed piping is run it would be well to hang pipe so there is a ¾-inch clear space between pipe and ceiling to admit tools for the purpose of cutting run to insert tees.

In conclusion, would say that the matter of piping for appliances comes so close to the commercial man that it behooves him to be on the alert and see that the proper sized piping is run to all appliances, so that all our customers may obtain satisfactory service from the appliance installed, and that we do not have to be continually tearing up their premises to run larger sized pipes. Put just a little more money into good, first-class appliances and good-sized piping and you will not be under continual expense for maintenance or rehabilitation work. Everybody hates to pay out money for repairs, and when you are placing an appliance for anyone is the time to get the money required to have it installed properly, and do not place yourself in the position where you will have to go to anyone and ask him to spend money for repairs or maintenance.

Fuel System.—All piping for a separate fuel system must be taken from the service pipe, a separate meter provided, and must be run and used for supplying gas for fuel only.

Size and Length of Tubing and Greatest Number of Openings Allowed in Piping Buildings for Use of Fuel Gas.—This Table for Dwellings, Apartment Houses and Flats Only. —Length of Pipe in Feet.

Number of ¼-inch. Openings.	½-in. Pipe.	¾-in. Pipe.	1-in. Pipe.	1¼-in. Pipe.	1½-in. Pipe.	2-in. Pipe.	2½-in. Pipe.	3-in. Pipe.	4-in. Pipe.
1	15	50	80	100	150	200	300	400	500
2	..	30	60	100	150	200	300	400	500
3	..	..	40	100	150	200	300	400	500
4	..	..	20	80	120	200	300	400	500
5	..	..	..	50	100	200	300	400	500
6	..	..	..	30	80	200	300	400	500
7	..	..	..	25	70	200	250	350	500
8	..	..	..	20	60	150	250	350	500
9	..	..	..	...	50	120	220	300	500
10	..	..	..	...	40	80	200	300	500
11	..	..	..	...	35	70	180	250	400
12	..	..	..	...	30	60	150	220	400
13	..	..	..	...	25	50	120	200	350
15	..	..	..	...	20	40	100	150	300
20	..	..	..	...	...	30	70	120	250
25	..	..	..	...	...	25	50	90	200
30	..	..	..	...	...	20	40	60	170
35	..	..	..	...	...	...	30	40	150
40	..	..	..	...	...	...	20	30	120
45	..	..	..	...	...	...	...	25	100
50	..	..	..	...	...	...	...	20	80
65	..	..	..	...	...	...	...	...	60
75	..	..	..	...	...	...	...	...	40
100	..	..	..	...	...	...	...	...	20

No illuminating flames will be allowed, and no branches or outlets provided for other openings than those intended for fuel appliances, such as fireplaces, kitchens and laundries. Illuminating burners will positively not be allowed on fuel systems under any circumstances.

Rules Governing Size of Pipe.—To govern the size of piping to be used for fuel systems, the following rules should be followed:

Consider that each apparatus will be used to its maximum, and all pieces at one and the same time. Use as a

basis for figuring pipe the following in ordinary residences and flats: Kitchen, 3 openings; laundry, 1 opening; each fireplace, 1 opening. An opening is figured to be ½ inch. For large buildings, consult the company for sizes of piping required. No fuel opening should be less than ½ inch. In figuring up the number of openings to be supplied, use the following relations:

One ¾-inch opening = two ½-inch opening; one 1-inch opening = four ½-inch openings, or two ¾-inch openings; one 1¼-inch opening = seven ½-inch openings, or four ¾-inch openings, or two 1-inch openings; one 1½-inch opening = twelve ½-inch openings, or six ¾-inch openings, or three 1-inch openings; one 2-inch opening = twenty ½-inch openings, or ten ¾-inch openings, or five 1-inch openings, or three 1¼-inch openings, or two 1½-inch openings.

If exact number of openings required is not given in the table, use the next larger size of pipe. Openings ½ inch in diameter will be allowed only when the maximum amount of gas to be used through them does not exceed 50 cubic feet per hour for each opening.

		Length of Pipe.		Inches.
Do not run over		15	feet of	½
"	"	50	"	¾
"	"	80	"	1
"	"	100	"	1¼
"	"	150	"	1½
"	"	200	"	2
"	"	300	"	2½
"	"	400	"	3
"	"	500	"	4

Residence or flat of 12 rooms or under: Kitchen openings, not less than 1 inch; laundry openings, not less than ½ inch; fireplace openings, not less than ½ inch.

Residence or flats of 13 rooms and over: Not less than 1 inch; not less than ¾ inch; not less than ½ inch.

All Ruud, Monarch and Columbia water heaters and heaters of this type should be provided with separate runs, as provided in the following table:

Columbia.	Monarch.	Ruud.	No. of Openings.
No. 0	No. 0	No. 3	7
No. 1	No. 1	No. 4	7
......	No. 2	No. 6	12
......	No. 3	No. 8	20

Hotels, boarding houses, restaurants, etc., should be considered special. The table is sufficient to cover almost any case of fuel piping sizes that may arise, but it is advisable for architects, builders, and others installing fuel piping systems to confer with the company's inspectors on all such installations in large buildings. Openings for fuel appliances should, as a rule, be 12 inches from the floor and project 1½ inches clear from the finished wall. All other rules for piping and inspecting not inconsistent with these, will be the same as for the illuminating system.

For Gas Engines.

Size of Engine.	No. of Openings.
1-horsepower	4
2-horsepower	7
5-horsepower	12
7-horsepower	12
12-horsepower	20

Supply for gas engines must be separate, and an independent service will be required, unless a governing holder or other similar device, acceptable to the company, is used. It is advised that before proceeding with the installation of gas engines, or piping for same, consultation be had with gas company's inspector.

A CONTINUATION OF THE REPORT OF COMMITTEE ON ELECTROLYSIS, PREPARED FOR THE AMERICAN GAS LIGHT ASSOCIATION.

Detroit, Mich.—The results of an electrolytic survey of the water and gas pipes of Detroit, made by Mr. A. A. Knudson, in 1905, are given in a report addressed jointly to the Board of Water Commissioners and the Detroit City Gas Company. The following abstract of this report is given with the permission of the above parties:

The present situation in Detroit, as a result of previous attempts to avoid damage by electrolytic action, is briefly as follows:

In 1896 the first examination authorized by the Board of Water Works appears to have been made under the supervision of the then General Superintendent, Mr. L. N. Case.

At that time there were three electric railway companies operating in the city, the Citizens, the Detroit and the Fort Wayne and Belle Isle Railway Companies. The latter was not considered a source of danger, its system being comparatively small.

The plan for protection which was pursued is outlined in the following extract from Mr. Case's report: "The necessity, first, is to keep the electricity off the pipes as much as possible in those districts where there is a tendency to overflow from the rails. This can be accomplished by providing a more liberal system of return conductors. The uninterrupted conductivity of the rails should be first insured, an additional feeder of copper wire being sometimes used independent of the rails. The next step is to arrange special return wires from the pipes to the rails or to the return cables in what are known as the danger districts, which are almost entirely within a short radius of the power houses."

The quotations are made for the purpose of establishing the origin of the bonding system found generally in vogue in Detroit upon the water mains.

The bonding of gas mains to the railway returns was probably begun in June, 1903. It was found necessary to place bonds around the lead joints of the 12-inch wrought iron main in Riopelle street, to prevent their melting out, owing to the heavy currents flowing through them, which were caused by its connections with the railway returns. A few other bonds have been placed upon gas mains at other points in the city.

We will now consider the situation as found at the present time. Since the first bonds were placed upon the water mains the railway companies have combined and are now operating under one management, called the Detroit United Railway Company. This company has freely co-operated with the Water Department in efforts to avoid electrolysis. They have installed bonds and connections to pipes with their returns at their own expense, first obtaining the consent of the parties owning the same, and are keeping watch through annual voltmeter surveys of danger districts in all parts of the city.

Over 150 measurements were made upon the water mains, and nearly as many upon the gas mains. The danger points in Atwater street refer to gas entirely. One service pipe was found leaking where it was exposed by the excavation for the new 10-inch water main, which leak was due to electrolysis.

This (+) condition of gas pipes is, without doubt, caused by both the fire main and the water main in the street being bonded to the railway return. The recent bonding of the fire mains has brought about this result in several places in the city, one marked instance being at Cass avenue and Lafayette street, where both water and gas mains are positive to those mains, and another at Miami avenue and Witherall street; at the latter place the two water mains and the fire main have been bonded to-

gether. The 4-inch gas main found at this opening was considerably damaged by electrolysis.

Jefferson Avenue—Several gas service pipes have been destroyed through this part of the street, and about 30 feet of 4-inch cast iron main replaced with new pipe, all owing to electrolysis. Between October 17th and 31st, the 4-inch cast iron gas main was bonded to the 12-inch wrought iron gas main by the railway company with a view to stopping further damage.

It should be understood that as the 12-inch wrought iron gas main is connected to several railway negatives, both underground and overhead, which lead direct to the power house, bonding the 4-inch gas main to it, practically connects the entire system of gas mains in this vicinity to the railway returns. The same may be said of another case of bonding at Fort and Riopelle streets, where the 4-inch gas main was bonded to the 8-inch water main, the water main being already connected to an overhead negative.

At Fisher avenue we find a maximum flow of 341 amperes. This is further added to as shown at Field avenue, making 373 amperes, the flow being west at both tests. At Bellevue avenue (same time of day as at Field avenue) it is 148 amperes.

At Meldrum avenue the 42-inch main turns north and thence goes through Congress street. As the pipes and rails on Jefferson avenue are bonded at nearly every street running north and south, a flow south is found, where tests have been made, to the pipes in Jefferson avenue as far as Riopelle street. At this point all pipes, both water and gas, are bonded not only to rails, but to special cables, both underground and overhead, running to the power house at the foot of this street.

There are two large gas mains in Riopelle street crossing Jefferson avenue, one a 12-inch wrought iron main previously spoken of, and the other a 16-inch cast iron main; both are carrying railway current, but the 12-inch main, owing to the screw coupling joints making the best conductor, as against the lead joints in the cast iron main, carries much the greater current.

The drawing (not reproduced here) shows the method of bonding around the several cast iron parts in the 12-inch main containing lead joints. This copper cable was placed in this way so as to prevent the lead joints from melting, as had been the case in one or two instances, due to the heavy current passing through the main since it was connected to the railway negatives.

The other two one-million cir. mils cables connect with other larger cables which lead to the power house.

The Twenty-four Hour Test.—In view of the heavy flow of variable current at times upon this main and the desirability of establishing the readings at any time in 24 hours for future comparison, a series of highest and lowest millivolt (1 millivolt = 0.001 volt) readings was taken every five minutes, beginning at 5 p. m., October 17th, and ending at 5 p. m., October 18th. The current flow in amperes was deduced and plotted, and also the power house log was plotted for the same hours. The relative plots showed very faithfully the variation of current strength on the 12-inch main to be synchronous with that of the power house, making the identification of the source of current on the main complete.

Increase of Railway Current.—As a traction system expands and more cars are added, more current is required to move the same, consequently an increased amount of current will return by the mains.

Another reason for the increase of current strength upon underground mains is the bonding of mains to rails or to negative busbar, also bonding one set of mains to another, such as gas mains to water mains. An idea of such an increase is given in the following comparative tables, in which an average is obtained of three readings selected from the evening load at the power house and three readings from an evening load on the gas main, showing the per cent. of increase in the past two years:

Switchboard Readings D. U. Railway Power House During Evening Rush Hour Years 1903 and 1905					Current Flow on 12-Inch Wrought Iron Gas Main. Years 1903 and 1905				
Time	Date	Amps.	Ave.	Inc.	Time	Date	Amps.	Ave.	Inc.
P. M.	1903 May				P. M.	1903 May			
5.00	28	11,000			5.00	28	2,290		
5.30	"	13,500	13,000		5.45	"	3,050	2,848	
6.00	"	14,700			6.00	"	3,205		
	1905 Oct.					1905 Oct.			
5.00	17	19,000			5.00	17	3,400		
5.30	"	20,000	20,000	53%	5.45	"	3,600	3,410	20%
6.00	"	21,600			6.00	"	3,250		

Fire Department Mains.—This system of mains is used solely for fire protection and they are generally known and spoken of as "Fireboat Mains," as during fires, water from the Detroit river is pumped through them by a fireboat.

These mains, which are so important to the city, have been seriously affected by electrolysis. We have already referred to one of the effects of current flow through them —the possibility of damage at joints. These mains, as well as the gas and water mains, are connected with the negative return to the power house, the connections, with few exceptions, having been made during the past summer.

Current Action at Joints.—During this survey the question arose, in the event of further bonding being allowed from gas and water mains to fire mains, how much added flow could be delivered to the fire mains without danger of melting some of their lead joints. (The details of the tests made to determine this are omitted, but the conclusions are given.

Conclusions and Suggestions.

Bonding.—"The bonding of water mains to railway return conductors, as a protection from electrolysis, was commenced in Detroit in 1896, and has continued to a more or less extent since then. The traction system was small at that time as compared with the present. It was supposed then, no doubt, that the same method would answer for large, as well as for small systems.

"Where the safety of all underground pipes is considered in the streets of a city, we are of the opinion that it is not wise to depend upon the bonding method as a final cure for electrolysis, especially where a large traction system using a ground return is in operation.

"Where such a system has been in vogue for several years, however, as in Detroit, it is not advisable to make any sudden or radical change without first having a substitute in use known to the equally efficient.

"Referring to other methods of protection, we quote the following extract from A. V. Abbott's work, entitled, 'Electrical Transmission of Energy,' 1904, page 102 (an authority on the subject), which we believe will apply to the situation in Detroit. After referring to damage by electrolysis to underground pipes, lead cables, etc., he says: 'On account of these difficulties the larger roads are now aiding the ground return by re-enforcing it with copper wire return feeders, looking in the near future to a more or less complete metallic cicuit for the railway system.'

"While the complete metallic circuit, such as in practical use in New York, Washington and Cincinnati (conduit system and double overhead trolley) has not come into general use, the tendency, at least among large railway systems, as Abbott indicates, is in that direction, and something of this kind should be adopted in Detroit.

"If the complete metallic circuit is installed there will, of course, be no further danger from electrolysis of under-

ground mains. In the meantime the situation in Detroit will have to be considered and dealt with as found.

"The system of bonding, while it has advantages, has also disadvantages; for instance, where one set of mains, such as water mains, are bonded to the railway return conductors, other mains in the same streets are, on this account, made electro-positive to them; and, unless also bonded, will be injured by electrolysis. This is the experience covering several years in Detroit.

"Another result from bonding: A much greater flow of current is invited upon the mains and electrolysis action at joints is apt to occur, especially when the currents are heavy. On account of these and other objections, we have never favored the method of bonding mains to rails or to negative returns, preferring means to keep currents off mains, rather than recommending means which make them a part of the return circuit to their detriment.

"In Detroit, however, we find at the present time the water mains and fire mains bonded and the gas mains also bonded to some extent. To prevent immediate electrolytic action upon the gas mains that are now in danger, it will be necessary to bond them also, at least as a temporary measure, until the railway company so improves its return system as to relieve the flow of current upon all underground mains in the city.

"Mr. Burdick, superintendent of motive power of the D. U. Ry., has informed us he stands ready to do this, and, therefore, we have reason to expect a substantial improvement in the near future in the reduction of the heavy currents now passing through some of the mains, as well as from one system of pipes to those of another system.

"Joint Melting Test.—This has been explained in detail and is important in determining what was hitherto unknown, viz., how much current a lead joint will stand before melting. It was found that a poorly-made joint, with much less lead than the average, in an 8-inch water main, in service 38 years, tested in the open air, no water inside, required a current of 2,600 amperes for 14 minutes to cause the lead to melt. More perfect joints will stand more current without failure under the same conditions of test. In view, however, of weak or imperfect joints, such as may be in smaller water mains or in a gas main that is near the surface of the street, subject to changes of temperature and the consequent expansion and contraction, causing high resistance, it is not safe to permit any such flow of current through mains of any size containing lead joints.

"Taking all sizes and kinds of underground pipes, length of service, etc., into consideration, it is our judgment that a maximum flow of 900 amperes is the highest that should be permitted upon any underground main, so far as danger of melting the lead joints is concerned.

"Electrolytic Action at Joints.—Many joints have been examined, both gas and water, in the cast-iron mains, interior as well as exterior. The result has been that, while in some cases evidence of electrolytic action has been found, as a whole no serious damage can be reported. The sizes of joints examined were from 4-inch up to 12-inch. As a rule sizes above 12-inch are not as much affected as the smaller ones, owing to greater surface contact of the metals and consequent lower resistance. It is to be observed, however, that the heavier the flow of current through the mains, the more chance there is for electrolytic action at the joints that are more or less imperfect. The flow of nearly 400 amperes on the 42-inch water main in Jefferson Avenue is for this and other reasons deemed liable to be injurious at some joints in this main.

"The rails are well bonded, but the principal cause for diversion of current to this main is that the mass of cast iron in the main offers a conducting path which competes successfully with the rails in carrying capacity.

"Another instance is a joint in a 24-inch main which shows high resistance even after being newly caulked (owing to a leak) at Congress and Randolph Streets. The flow at one test through this main was 203 amperes.

"This joint is still in service, and exterior examination shows electrolytic action on the (+) spigot side close to the lead packing. As a rule, however, we have found very few joints showing high resistance. A reason given by Mr. Hubbell is that much care is given to the packing of all lead joints. This statement is borne out by personal observation.

"The Twenty-four Hour Test.—The curve sheet shows the minimum and maximum strength of current during the 24 hours returning through the 12-inch wrought-iron gas main. This main is connected by heavy copper cables to the power house, which accounts for the heavy flow, at times above 3,000 amperes. The power house load current is also plotted on the same sheet and shows the similarity in variations at the same hours. The railway company has agreed to substantially reduce this flow upon this main by constructing additional track auxiliaries.

"Attention has been called to the increase of current strength of the traction system during the last two years. A short table shows 53 per cent. increase in two years' time at the D. U. Railway station, and 20 per cent. at the gas main above referred to, between the years 1903 and 1905.

"As it is probable that the same ratio of increase may be expected in future, unless a change is made, it is our opinion that a condition is being approached which makes it imperative that the railway company should make such change as soon as possible, at least before another summer's traffic commences."

REINFORCED CONCRETE CONSTRUCTION ON THE PACIFIC COAST.

Already it is quite apparent that reinforced concrete is to enter largely in the reconstruction of San Francisco. There is scarcely a block in the down-town burned district that will not soon boast of at least one reinforced concrete building, for they are to be seen on every hand in various stages of construction. A five-story building on the corner of Geary and Market Streets, is the first structure of this kind to be occupied, while several others of from three to seven stories are in course of erection.

The most notable reinforced concrete building which has yet been announced for San Francisco is to be erected on the corner of Fourth and Market Streets, the site of the old Flood Building. It will be nine stories high and will cost $1,000,000. Its exterior, for the first two stories, will be veneered with ceramic tile in rich browns. Above the second story the entire front will be faced with cream-colored glazed terra cotta in rich detail. The corridors and lobbies will be finished in imported marbles, and six electric high-speed elevators will be installed. One remarkable feature of this concrete structure is the fact that nine stories are made possible within the limit of height to which concrete buildings are restricted by the city ordinance—one hundred and two feet. The first story will have a height of twenty feet; the second, twelve feet; and the other stories, ten feet each. By an ingenious arrangement of the structure, the fact that the roof is of concrete makes it possible to dispense entirely with an attic story.—"Scientific American."

ILLUMINATING ENGINEERING SOCIETY ELECTION OF ADDITIONAL OFFICERS.

Nominees by Board of Nominators:—Vice-Presidents—Chicago Section, Albert Scheible; Pittsburg Section, G. B. Griffin; Philadelphia Section, H. K. Mohr. Directors—J. F. Gilchrist, G. R. Stetson, S. E. Doane.

The following is a list of the present officers and directors of the Society: President, Dr. Clayton H. Sharp. Vice-Presidents—New York Section, A. A. Pope; Boston Section, Dr. Louis Bell; Secretary, V. R. Lansingh; Treasurer, Dr. A. H. Elliott. Directors, E. C. Brown, W. S. Kellogg, E. L. Elliott, W. D'A. Ryan, W. D. Weaver.

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Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," with which is incorporated "The Engineers', Architects' and Builders' News."
Entered as second-class matter at the San Francisco Post Office, August 15, 1899.
Entered as "The Electrical Journal," July, 1895.
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VOL. XVIII MARCH 9, 1907 No. 10

EDITORIAL.

Direct or Alternating Current for Long Transmission Lines.

In England and on the continent of Europe, there has recently been much written and published in the technical press regarding very long transmission lines, where the conditions would seem to require higher line voltages than have heretofore been successfully used in electric transmission. Many eminent engineers have not hesitated to place themselves on record as favoring the use of direct current instead of the three-phase alternating current for very long, high voltage lines. On the other hand, at least one well-known American electrical engineer has, in effect, discarded with seemingly little consideration, the proposal to use direct current for the transmission of 50,000 horsepower a distance of between 600 and 700 miles, the suggested line voltage being 150,000 volts. His decision is, tersely stated, that there is no question but that the three-phase alternating current should be used. Those familiar with the extensive developments in long distance electric transmission on the Pacific Coast, it must be said, are somewhat inclined to agree with him.

Many points need the most careful consideration in a transmission system 700 miles long at 150,000 volts between conductors, using three-phase alternating current. A sufficient investment in electrical conductors will result in the transmission being satisfactory merely from the standpoint of efficiency or the ratio of the electrical energy delivered to the receiving end and the electrical energy delivered to the line at the generating end. The problem of voltage regulation, however, is an entirely different matter, and may be quite independent of the cost of the line, whether great or little. It may be safely said that in all probability the generating station, step-up transformers, oil-break high tension switches, as well as the sub-stations with their equipment, would not differ materially from those in existing plants, except in the matter of the size of units. The adoption of the three-phase alternating current results practically in concentrating all the important problems and probable difficulties on the transmission line alone.

On the other hand, if direct current were used, the generating and receiving stations, and particularly their equipments, would differ greatly from those now in use, and the multiplicity of machines required for series operation, with their commutators, would probably remind one of the early days of arc-lighting stations, except that the station would certainly be on a gigantic scale as compared with our old constant current arc dynamo equipments.

With direct current, however, the line, even using 150,000 volts between conductors, should not introduce any new troubles other than those which have been successfully overcome at the present time. Except for the tendency of electrolytic action of the direct current, it is probable that the electrostatic strain on the high tension insulators would not greatly exceed that which exists on operating transmission lines where the line voltage is from 60,000 to 80,000 volts, three phase. With direct current, then, by far the largest part of the difficulties of operation would be found in the generating and sub-station electrical apparatus, rather than on the transmission line.

Outside of the necessity of designing and constructing the high tension insulators for such an extremely high line voltage as 150,000 volts, as viewed at the present time, for regular continuous operation, the matter of the so-called charging or capacity current in such a long line is undoubtedly of the most importance, and not only must the charging current be given the most careful attention, but also other phenomena which result from the large capacity and self-induction of the line.

This, however, can be controlled if a sufficiently low frequency is adopted. Certainly 60 cycles, or even 30 cycles, could not be successfully used, and it is also true that on the receiving end it would be necessary to introduce machinery, whether synchronous or induction motors, which would when required operate at a comparatively low power factor, utilizing lagging current to balance the heavy capacity current of the line. It can be shown that the regulation of voltage, with a sufficiently low frequency, is readily accomplished, when the efficiency of transmission is as high as 85 to 90 per cent. It would be absolutely necessary, however, to introduce an artificial inductive

load upon the receiving end of the line, if for any reason the regular operating load should be suddenly disconnected.

From a commercial standpoint, the building of such a long transmission system will depend only upon the cost of power at the receiving end. At 6 per cent. interest on the investment required for the line alone, the cost of transmission per kilowatt per annum for fixed charges would be about $10. To appreciate the magnitude of this charge, it is said that the cost per kilowatt per annum represented by the fixed charges at 6 per cent. of the cost of the line for a 10,000 kilowatt, 60,000 volt, 150-mile line on the Pacific Coast, does not exceed $1.00 per kilowatt per annum.

TRADE CATALOGUES.

Fort Wayne Electric Works' latest publications are as follows:

Instruction Book No. 3,024 gives a complete description of the Fort Wayne system for alternating-current series arc lighting, with careful instructions for the installation of each part from transformers to lightning arresters.

Index to Bulletins Nos. 1,001 to 1,089, covering a list of all bulletins ever issued by the Fort Wayne Electric Works. The Index has been classified in two ways; first, according to subject, and, second, according to number.

Bulletin No. 1,087 describes a standard form of direct-current switchboard panels, and

Bulletin No. 1,089 is devoted to the same thing for single-phase alternating current.

Half-tones and diagrams are complete in both cases.

Bulletin No. 1,090 shows the necessary parts for the installation of a series alternating-current arc lighting system, with data for switchboards, lightning arresters and transformers.

Allis-Chalmers Co.—"Gold Milling in the Black Hills" is the title of Bulletin No. 1420. This is a reprint of a paper prepared by Professor H. O. Hofman, of the Dakota School of Mines, and contains a great deal of matter which will be found of practical value by those who are interested in propositions involving ores similar to any that are mined in the Dakota District.

Allis-Chalmers Co.—Bulletin No. 1,050, entitled "Alternating-current Generators, Water-wheel Type," is a revision of a previous bulletin on the subject. The rapidly-growing number of electric installations renders the subject one of increasing importance, and for that reason will prove of general interest. It is well illustrated.

The Electric Storage Battery Co. has just issued an attractive pamphlet entitled "The 'Exide' Battery Instruction Book." It covers a description of battery parts with general directions for charging and the proper care of the various types of batteries.

If copies are desired or additional information not contained therein is wanted, the above company will furnish it from their main or any of their sales offices.

Power & Mining Machinery Company.—One of the most beautiful specimens of printers' art that we have ever seen is the recent catalogue on "Cement-making Machinery," issued by the Power & Mining Machinery Company, of Milwaukee.

National Brake & Electric Co.—Bulletin No. 373 gives a very clear description of National Motorman's Valves, with half-tones of all the parts. This, together with other bulletins giving full description of each part of National Air Brake Equipments, will be forwarded upon request.

As examples of efficient and up-to-date advertising as practiced by progressive central station companies, we would refer our readers to a neat little illustrated booklet devoted to the possibilities of the electric current for "Heat, Power and Light," issued by the Denver Gas & Electric Co.

Also the Valentine number of "Edison Light," a publication issued by the Edison Electric Illuminating Company, of Boston.

The Benjamin Electric Manufacturing Co. has just issued a beautiful little catalogue of their specialties for the benefit of the Mexican and South American trade. It is printed entirely in Spanish, and we have no doubt but that it will prove of interest and value to our Southern neighbors.

OBITUARY.

The death of George Henry Evans at Berkeley on February 4th has caused wide-spread regret in San Francisco, where he had a large number of friends. Born at Hull, in England, forty-one years ago, he was a mining engineer in active and successful practice. His specialty was placer mining, he being the inventor of the Evans Hydraulic Elevator now used in most hydraulic mining, where the elevation of gravel is necessary. He was a member of the North of England Institute of Mining and Mechanical Engineers, American Institute of Mining Engineers, American Society of Mechanical Engineers, Technical Society Pacific Coast, Franklin Institute, and also a member of the Bohemian Club of San Francisco, where he had a wide circle of friends. He leaves a widow, son and daughter. He came to California ten years ago, to take charge of the operations on the Golden Feather Channel, at Oroville, succeeding Col. Frank McLoughlin as manager. This position he occupied for three years and then he became manager of the Banner Mine, also in Butte County. Subsequently he traveled widely, becoming consulting engineer of various alluvial enterprises in Colorado, California and elsewhere. He was one of the consulting engineers associated with the Risdon Iron Works. As a member of several engineering societies he had a wide acquaintance, among whom a kindly disposition and cultivated manner made him always welcome. The engineering profession has lost a worthy member.

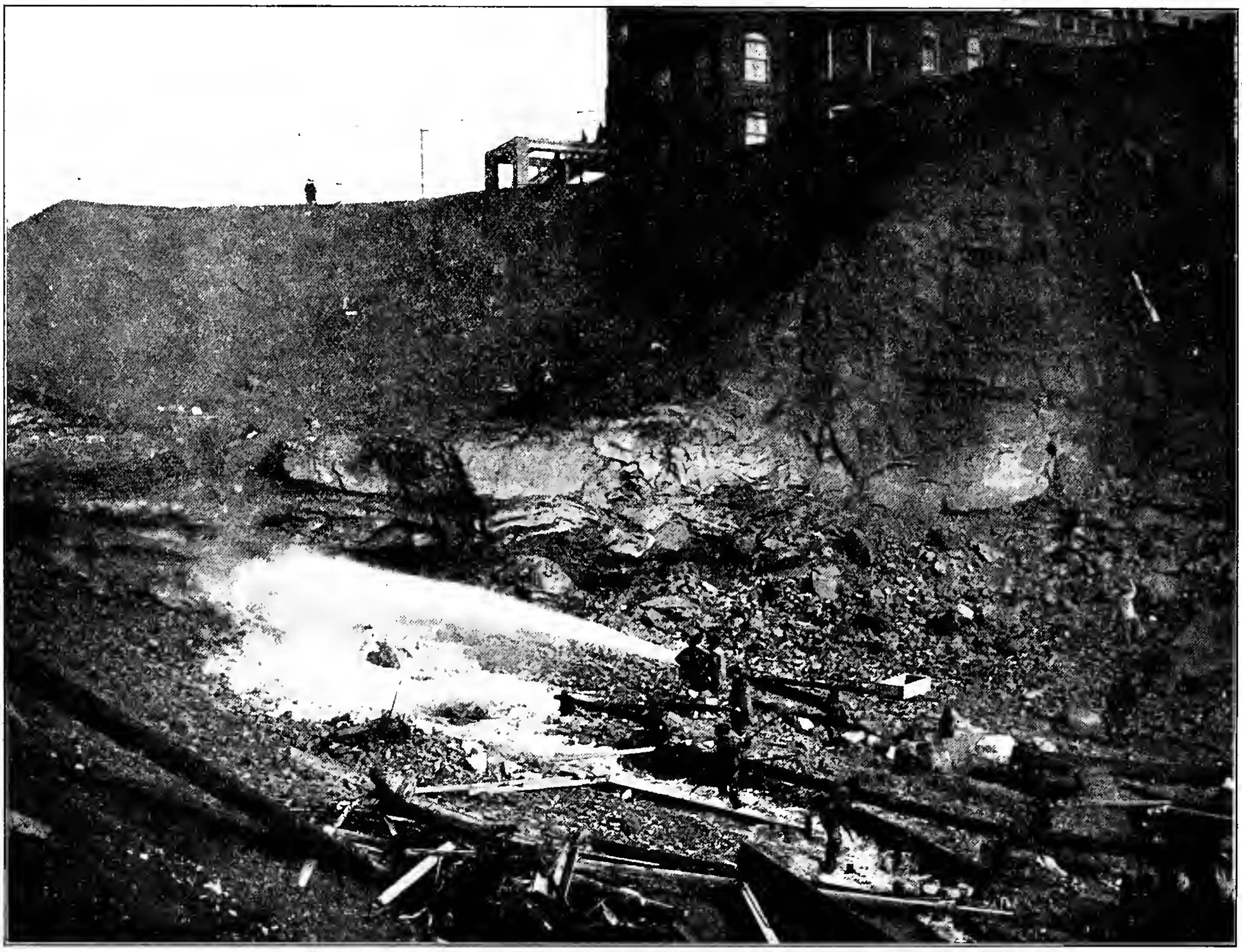
TURBINE BLADES.

The three turbines of the "Carmania" contain in the aggregate a million and a quarter of blades, and those of the "Lusitania" will have approximately three millions of blades together. This means probably over one million of blades for each of the low-pressure turbines The number of blades in the largest turbine which the Westinghouse Company has yet built is something over 85,000, but these turbines being built for electrical station purposes run much faster than the marine turbines, which latter have therefore a much larger number of blades. While the insertion and fastening of all these blades may present a problem to the manufacturer, the entire rotor shaft and attached blades are, so far as the operating engineer is concerned, a single piece. The blades when they leave the builders' hands are really integral with the spindle and case.—Power.

ELECTRO-HYDRAULIC EXCAVATING.

The use of hydraulic methods for removal of earth for various purposes has proven itself the most economical and efficient method where a good supply of water is accessible.

This process has been quite successfully utilized by Mr. H. W. Hawley, of Seattle, in connection with the excavating of the hilly section of that city. He has entered into a contract with several private property owners covering the removal of Denny Hill, one of the prominent landmarks of Seattle, and the site of the Washington Hotel.



SIX-INCH GIANT WORKING ON DENNY HILL, HAWLEY PLANT, SEATTLE, WASH.—WASHINGTON HOTEL, NOW BEING DEMOLISHED, IN BACKGROUND.

Heretofore water has been secured for sluicing from the city water system, which derives its supply from Cedar River, distant approximately thirty miles from the city, but owing to the recent large increase in demand upon the city plant consequent to the rapid growth of the city, the municipal authorities have been compelled to discontinue the disposal of water for purposes other than those usually imposed upon such a system. It was owing to this condition that Mr. Hawley decided to install a sea water pumping plant, taking water from Puget Sound at a point approximately 2,500 feet distant from the point of consumption.

The plant consists of a 600-kilowatt, 2,400-volt, 2-phase, 60-cycle, speed 327 revolutions per minute, Westinghouse synchronous motor, carrying the rotor of a 40-horsepower, 440-volt, 2-phase induction-starting motor mounted on an extension of its shaft—the stator of the starting motor is bolted to a bracket carried on the main bearing pedestal of the large machine. This induction motor has a synchronous speed of 400 revolutions per minute, and is controlled through an auto-starter mounted on a separate panel of the switch-board in the regular manner.

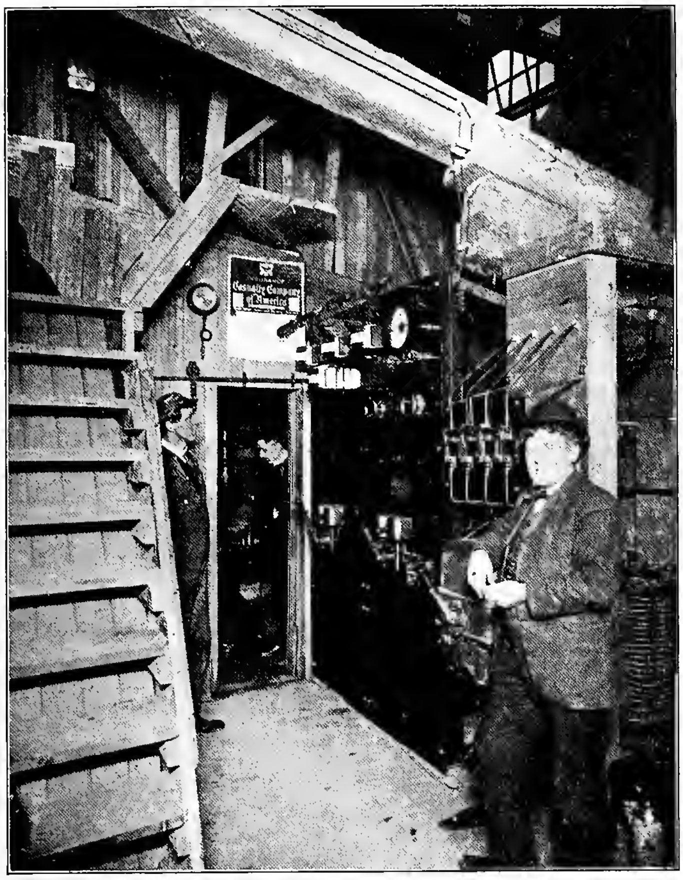
Current for the operation of the plant is secured from the system of The Seattle Electric Company; the 2-phase, 440-circuit for the starting motor being carried direct from transformers placed on a pole outside of the station to the starting motor panel. The 2,400-volt, 2-phase circuit is carried to disconnecting switches placed outside the building and thence to a feeder panel.

The switch-board consists of two panels carrying voltmeters, ammeters, automatic oil circuit breakers, synchroscope and the necessary busbars and small wiring.

The exciter is driven from a pully mounted on the main shaft of the synchronous motor, and is controlled from the operating panel of the switch-board.

Power is transmitted to a 30-inch, 4-stage Worthington turbine pump, through a friction clutch of special design to the main driving pulley which is belted to the pump pulley through the medium of a 48-inch, 4-ply leather belt. The pulley ratio is such as to operate the pump at a speed of 500 revolutions per minute. The belt tension is adjusted by raising or lowering an idler pulley placed about twelve feet from the pump pulley.

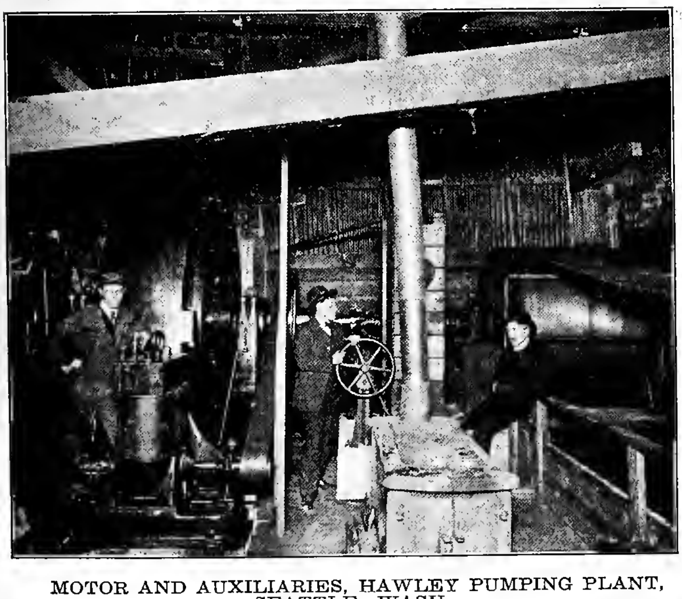
The pump has developed a capacity of 4,000 gallons per minute against a gauge head equivalent to 430 feet, and is capable of delivering water at the nozzle of a 6-inch giant



SWITCHBOARD, HAWLEY PLANT, SEATTLE, WASH.

working at the highest elevation required at a pressure of 120 pounds per square inch. The matter to be excavated consists largely of blue clay and is exceedingly tenacious and difficult to move. However, no difficulty has been experienced in the present instance, and the plant has proved to be thoroughly satisfactory in every way.

The hydraulic end of the plant was designed and furnished by Caldwell Bros. Co., of Seattle, working under contract for the owner. The electrical portion of the plant was designed and erected by Kilbourne & Clark Company, of Seattle, under the supervision of Mr. Frederick G. Simpson, chief engineer of that company. All other parts of the installation were installed under the direction of Mr. George H. Tinker, engineer for Caldwell Bros. Co.



MOTOR AND AUXILIARIES, HAWLEY PUMPING PLANT, SEATTLE, WASH.

OUR BERLIN CORRESPONDENT.

Nothing is more interesting at present than the success experimenters here are having with the so-called "Kreissel Pumps," a centrifugal pump, having only three blades, and operated by steam turbines at upwards of twenty thousand revolutions. The friction losses, naturally, are high, but the total efficiency is proving high enough, that the manufacturers of high-speed turbines will doubtless take them up, for direct connection. In addition, it is certain that no other pumping plant of equal capacity could be constructed in as small a space.

Large and small steam turbines seem to be displacing all kinds of engines. Small steam turbines are becoming very popular, and in looking over the advertising pages of the engineering papers, one cannot help but note that the engines are disappearing from the advertisements as well.

From the splendid perspective of this distance, we note by the papers that you are growing, this year, an unusually large crop of second editions of Edisons and Bells. They shout forth the wonders of their new systems of railroading, telegraphy, or motors; promise to make every one rich who will buy a little of their stock. It is not always pleasant to have to explain to our scientific friends here the exact status of such muchly-advertised genius (?) in our country. This year I note wonderful promises regarding a so-called "Cold Motor," a new magnetic railroad, a Chicago-New York electric line, a new kind of magnetic phonograph exploited more on Wall Street than in the retail market, another convulsion of the Wireless Telegraph Trust, to say nothing of the present phase of wild-cat mining, which we had hoped had been burned out of San Francisco. How do you think we explain these things to our steady, conservative German engineers, who cannot comprehend anything that is not all that it is supposed to be, for the simple reason that nothing can exist here that will not bear thorough inspection; for the further reason that it actually will be inspected, and there is no dodging it?

Yesterday evening the local General Electric Co. gave a banquet and exhibition, in which a number of their turbines were exhibited. The Kaiser attended, and mingled freely with the guests, and talked freely with Prof. Slaby, who was present, and others. The lecture of the evening was given by one of the engineers, who showed how the company had developed a very successful turbine from the combination of the Riedler and the Curtiss turbines. The Emperor was very much interested, and inspected all of the exhibits with that lively interest which he shows in everything that is progressive and instructive. Incidentally, most of these engineers are invited to lecture before the Emperor from time to time, which is considered a very great honor, indeed.

It might be not out of place here to note that the German chemists, headed by the great Fischer, are the most advanced in the world. Their works on theory are accepted standards the world over. Fischer is said to have built up a true albument out of non-organic materials. The works of these gentlemen on the chemistry of agriculture and regeneration of worn-out soil are voluminous, and used the world over; yet Germany as a whole needs this regeneration more than any other country of the globe, and nothing is being done, although she is said to control nitrate beds, and other ingredients in different parts of the world, necessary to the purpose. This is a characteristic of German science, to study, rather than to use it.

Professors Stumpf and Riedler are said to be experimenting on gas turbines at their private laboratories, but it is difficult to obtain any information. It is said that they are meeting with great success, with the exception that reciprocating compressors have to be used, hence little is gained by using a gas turbine, since the reciprocating parts are not eliminated, and additional complications added.

Yours truly, E. N. PERCY.

INDUSTRIAL

GOLD DREDGING IN THE OROVILLE DISTRICT.

The writer is often asked by editors of progressive technical publications for a few lines on Gold Dredging, one and all stating that this simple, but little known, method of mining is now attracting more than usual attention, due, no doubt, to the fact of the large, steady dividends this method of mining is returning, and the writer predicts that it will not be very long before gold dredging will not be considered a mining proposition, but will be placed on the same footing as that of a first-class manufacturing industry, and one in which the market for the production is impossible to flood; also, last but not least, the price of the production never fluctuates.

It is not the intention of the writer to go into the early history of successful gold dredging, which, as most people know, has its home in the little, far-distant New Zealand, but rather to take up and describe one of the latest dredges operating in this State, and to the average man, whether he is in the engineering business or not, a trip to Oroville will more than repay him for his trouble and expense.

In Oroville one can see some forty dredges working within a radius of eight miles. These dredges are not, as most people suppose, working in the river, but some are on high land, two and three hundred feet above the level of the river. Of course, they are working in ponds, which receive the water from the river, taken out some miles up river, used for irrigating purposes. Now the irrigating ditches deliver the water into a small pond, in which floats the gold dredge (or a machine for extracting gold out of auriferous gravel), digging up the material in front and taking out all the fines deposited in the gravel when the earth was young, and stacking the waste material at the back of the dredge.

On an average this machine will handle approximately 50,000 yards per month, and the total working expenses are in the neighborhood of twenty-five hundred dollars per month. Therefore, if the ground is worth sixteen cents per cubic yard, one can readily see what enormous dividends this gold manufacturing machine pays.

One of the latest dredges working in the Oroville district is known as the "Baggett No. 1," built by the Risdon Iron Works, and is situated about two and a half miles from Oroville, on the highest ground in that district. As a general thing, the higher the ground the harder, and in this case the ground is not only hard, but it is also cemented so much that it is found impossible to excavate the pit in which the hull of the dredge was built, without the aid of dynamite.

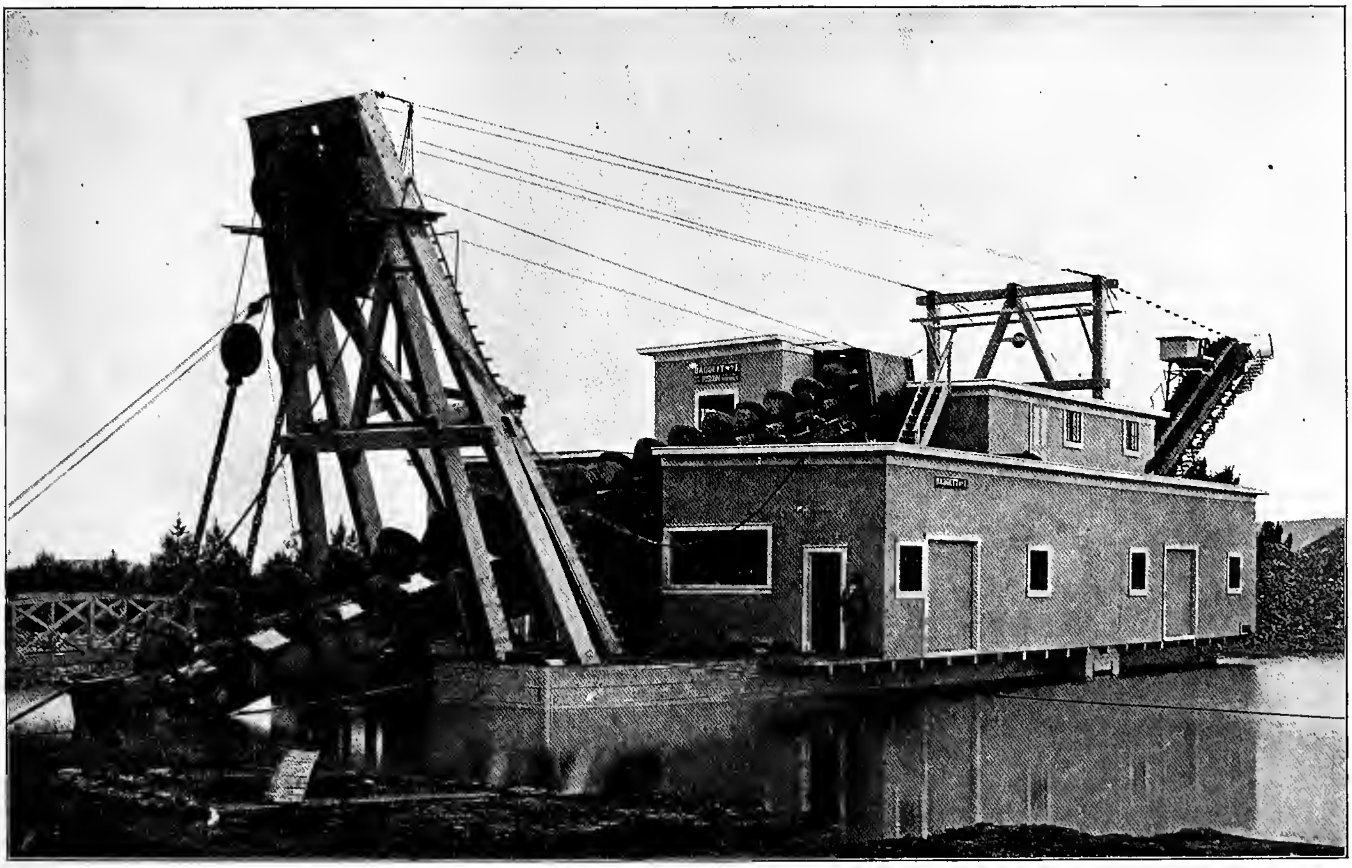
This dredge was erected and commenced operation, and for a time did heroic work in this very hard cemented gravel, but it has since been proven that it is more profitable to blast the ground in front of the dredge. This blasting is done by drilling holes six inches in diameter, with a drilling machine similar to that used for testing the ground, and going down some twenty feet (the ground in this case is thirty-five feet deep), and loading the hole with about eighty pounds of black powder, and firing in the usual manner. The holes are placed approximately twenty feet from the face,

and forty feet apart. This blasting costs in the neighborhood of two and a half (2½c) cents per cubic yard, which is more than offset by the increased capacity of the machine, to say nothing about saving the wear and tear.

This machine is of the usual Risdon design, with all of the latest improvements, having open type buckets of seven cubic feet capacity with revolving screen and bucket stacker. The hull is ninety-six feet long, thirty-four feet wide and seven feet deep, having rounded bows and rake-off at the stern. The hull is well reinforced by Howe trusses, which does away with the unsightly hogging rods, and has proved itself to be amply strong, when doing hard digging.

Hard digging is a poor description of the movements and strains that take place on the machine, and men, who are not accustomed to the work, are often made seasick; the writer has seen even Chinamen turn pale with the hull bouncing up and down two and three feet, as each bucket comes round the bottom tumbler.

bracing not only the top tumbler shaft, but also the hanger shaft on which the ladder is pivoted, together with the main counter-shafting, which carries the main pinion. The main ladder which hangs on the hanger shaft just mentioned is fitted with telescope or extension screws, which permit the distance between the top tumbler and the bottom tumbler to be decreased or increased to take up the stretch of the main bucket chain. This construction is only found in the Risdon dredge, but has time and again proved very useful, and saving a great deal of lost time, owing to the bucket chain stretching and becoming so loose that the chain leaves the bottom tumbler, while it is not slack enough to allow taking out a complete bucket. Thus the advantage of having telescope screws is very apparent. The only objection to the telescope screws has been the impossibility of getting the hanger shaft close to the top tumbler shaft, and this objection has been overcome by making the extension between the hanger shaft and the lower tumbler. By this method the



Beginning at the front of the boat, we first notice an improvement in the hoisting arrangement, which consists of a steel head frame, on which are attached the hoisting gear, consisting of two drums keyed onto one shaft, and driven by a variable speed motor through two sets of gearing. This steel frame is supported on six heavy timbers, which are some 42 feet long, and secured to the hull by means of a steel foundation frame, in all making a very substantial job, but nevertheless none too rigid for the work it has to withstand.

The stern gantry is of the usual Risdon design, consisting of two vertical posts sixteen inches square, forty-two feet long, which are supported on a heavy steel gantry, extending completely across the hull, and in turn rest on four keelsons.

The tumbler on the center gantry is built of steel throughout, having two heavy girders extending completely across the hull, which support steel main channels and plating, and at the top of this are situated the main tumbler bearings, which are of cast steel and of a new design, em-

hanger shaft is now placed within one-half inch of the outsides of the upper tumbler, and gives practically a straight lead to the bucket chain when working at various depths.

The main ladder is of the usual girder type, seventy-eight feet long, and five feet deep, plated on all four sides; the top and bottom having openings over which the ladder rollers are placed. These openings allow any spill to pass through and not collect on the ladder as in most designs, to say nothing about preventing the ladder rollers from revolving, and causing flats. The lower end of the main ladder is supported by two-inch chains and two single sheaves carrying plow-steel ropes one and one-half inches in diameter, one end being attached to the top of the steel frame of the bow gantry, passing down from the single sheave and back to the drum, which has turned grooves to exactly fit the rope. This hoisting arrangement is very simple and effective. There are no ropes stringing across the gantry at various angles, and guide sheaves are completely eliminated. Also the deck room in the operating house is very much increased and simplified.

The main buckets are of a very heavy design, having manganese and projectile steel lips. This was done for comparison, since in some ground it was found that projectile steel will last longer than the manganese, but in this particular case both lips seem to have about equal wearing value. The projectile steel does not cost over twelve cents per pound, while the manganese costs seventeen cents. The bucket chain and bushings are of forged manganese, which has proved to be superior to all other grades of steel.

The connecting links connecting the buckets together, are forged in one solid piece, thus making a bucket chain in which all risks of breakdown, due to faulty material, are eliminated. It is a well-known fact that it is impossible to get absolutely faultless castings, therefore the aim of the builders of this dredge is to use a material of absolute known quality. These forged steel connecting links, while costing more in the first place, will more than pay for themselves within a year or two, and have also approximately twice the wearing value of the cast-steel connecting links.

The gold-saving apparatus is of an entirely new design, which the builders have patented, and after going on board this dredge, one is struck with the quantity of deck room there is. The fine material, after leaving the revolving screen, falls onto a set of distributing plates, lined with riffles. These plates absolutely divide the material into two parts. Not only does it divide the quantity but also the quality. Thus, if a great deal of fine sand is passing into the revolving screen, it does not all go out on the one set of tables, but half is taken on one side, and half on the other. This is the first revolving screen to be fitted up in this manner, namely, to divide the material, both in quantity and quality, which is a very essential thing in gold saving.

But, to go back one step, the material after leaving the box at the top tumbler falls on to what is termed a rock-line chute, which has two distinct advantages. The first is that the material does not either stick to the chute, or slide at too great a velocity into the revolving screen, both of which are very undesirable. This is overcome by a very simple

arrangement; instead of making a chute of the usual design, a box is formed with a semi-circular outlet, and the material is dumped into this box until it will run out of its own accord. Thus the material falls on itself and saves the wear and tear of the old-style chute.

The top tumbler which drives the bucket chain consists of a sixteen and one-half inch square steel shaft, onto which are clamped wearing corners, and the old method of having a square cast-steel tumbler body keyed to a round shaft is done away with. This decided improvement, while being a little more costly, entirely eliminates shut-downs from the top tumbler getting loose on the shaft.

The bottom tumbler is of the usual design, having enclosed bearings and lubricated with grease—of such a design that it effectually prevents grit and dirt getting into the bearings.

The revolving screen to handle this hard cemented gravel is of the usual pattern, so constructed that all plates can be replaced without dismantling the screen. It is driven by friction rollers through a chain of gearing, and connected to an independent motor.

The washing device in the revolving screen is of the standard design, consisting of a number of nozzles, having a correct taper, which nozzles are strapped to a large pipe, and spray the water on to the material in the revolving screen in the form of heavy jets, instead of the spray design used on flat shaking screens. These heavy jets of water are very desirable when handling sticky and hard material, since it thoroughly disintegrates any clay, and allows the gold to be caught in the riffles.

At the stern of the dredge we find the usual Risdon stacker, and elevator, which consists of a continuous chain

of close-connected buckets, which has proved far superior to the rubber belt. This is becoming more marked every year, as the grade of rubber belt supplied is decreasing with the increased demand for rubber. The rubber belt, which would last twelve months, costing in the neighborhood of eleven hundred ($1100.00) dollars, will now not last half that time; in fact, a number of cases have occurred where the rubber belts have not lasted more than two and a half months, whereas the close-connected chain of stacker buckets, while not being so attractive to look at, will show a saving over the belt conveyor of forty per cent in up-keep, and thirty-five per cent less lost time, due to elevator repairs. There is also another advantage of the bucket stacker, and that is it will always carry the material whether wet or dry, whereas with the belt conveyor, should for some reason a little water pass through the screen on to the belt, the material will not be elevated, but will slide back, causing the dredge to shut down until this blockade has been raised. Nevertheless, some investors who see a brand new belt conveyor carrying a string of rocks silently and quickly up an incline of eighteen degrees, will prefer a belt conveyor, which have lower first costs than the reliable but absolutely certain chain of close-connected buckets.

The winches for manipulating this machine, together with the motors, centrifugal pumps, etc., are of the usual design, and do not call for any special remarks.

Cuts Nos. 1, 2 and 3 show various views of this dredge.

ELECTRIC EQUIPMENT FOR A WINERY.

The California Wine Association, which controls a large proportion of the California wine output, has purchased forty-seven acres near Point Richmond and is erecting an immense big plant which they call "Winehaven." The entire forty-seven acres will be covered with the manufacturing and storage buildings alone.

Electric power will be used largely throughout the plant for the various processes, and among others there will be six miles of switching track, with an electric locomotive. A 300-kilowatt engine installation is to be used with Westinghouse compound engines in the central power station.

The entire power equipment is so extensive and complete that Hunt, Mirk & Co., who have charge of the installation, estimate that it will take three years to complete it.

This enterprising firm also report the following turbine sales made by them. In view of the fact that the use of the turbine has only come into extensive use very recently, it speaks well, not only for the success of this type of prime mover, but also for the progressive spirit of the Pacific Coast.

The City Electric Co., of San Francisco, has purchased two 2,500-kilowatt, Westinghouse-Parsons turbo-generators, 11,000 volts. This company, representing the Fleishhacker interests, intends to enter the San Francisco field in a thorough way, as is evidenced by this order and by the further announcement that they intend to eventually increase the equipment by the addition of a 5,000-kilowatt unit.

The Los Angeles Gas & Electric Co. has purchased a 3,000-kilowatt unit, and the Gray's Harbor Ry. & Light Co. a 1,000-kilowatt set.

The entire January sale on steam turbines by the Westinghouse Machine Co. amounts to two units with an aggregated rated capacity of 25,000 kilowatts.

The Electric Storage Battery Company announces that they have opened a sales office at Atlanta, Ga. This office is located in rooms 1126-27 Candler Building, and is placed under the charge of Mr. Harold H. Seaman. Mr. Seaman was formerly engineer of the Cleveland sales office of this company, and his experience gained there will enable him to handle promptly all matters pertaining to the territory of Tennessee, North and South Carolina, Georgia, Florida, Alabama and Mississippi.

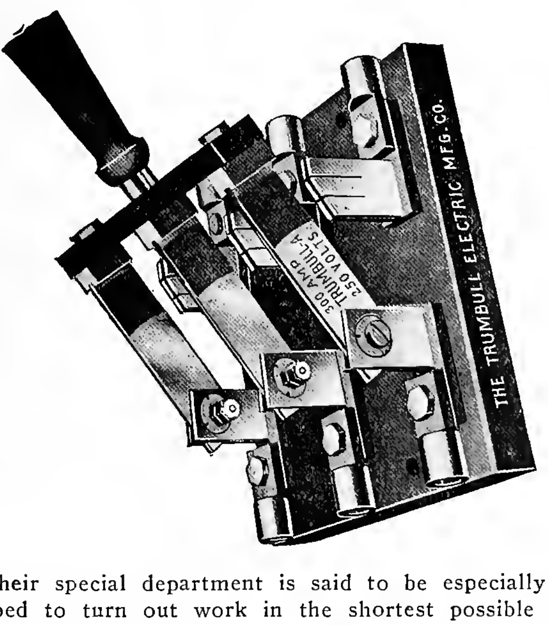
IS SWITCH MANUFACTURING A PRECARIOUS BUSINESS?

"The Manufacturing of Switches is a Precarious Business at Best" was the expressed opinion of a manufacturing expert who, having his ear to the ground, had noticed the rumbling and grumbling of late-moving days when so many small switch makers were forced to close up and larger manufacturers to cut out their switch line.

To quote another recent announcement, "Changes and rulings on the fusing of knife switches have been so many and have come so often in the last few years that a switch manufacturer, in order to supply the necessities of the trade, must go into the business in detail or find himself on the shelf. The increasing demand, also, for alternating current which requires an entirely different line of switches has added still further complications. The result is, that whereas a few years ago an assortment of a thousand switches was considered a good line, it requires to-day about thirty thousand different switches to constitute a complete line in any one style."

There is at least one glittering exception to these discouraging conditions, to wit, the Trumbull Electric Mfg. Co., of Plainville, Conn., who state that before long they are to publish their new catalogue which is to have the "precarious" distinction of showing the most complete line of switches ever published, requiring forty catalogue pages.

Trumbull's further announcement that about 45,000 separate switches are to be priced in this new catalogue does not stagger the unsusceptible mind so much when it is considered that every possible combination is to appear: front and back connected, quick break, double break, quick break and double break, fused and unfused, plain and polished, D C and A C—110-250-440 and 600 volts ranging from 15 to 2,500 amperes and covering in their respective classes both Type A (as shown in cut) and Type C switches. In fact, there is no knife switch which they cannot supply.



Their special department is said to be especially well equipped to turn out work in the shortest possible time. They add that this is true in part because they carry in stock more knife switch material than any one in the country. Customers are rarely kept waiting for lack of stock.

The design and workmanship of Trumbull switches certainly meet all the standards of a first-grade switch, if the careful conforming in all points of detail to the requirements of the Board of Underwriters and their approval of same, means a first-grade switch.

Their Type A switches go much further than this as recent tests in the Electrical Testing Laboratories of New York (noted authorities on electrical testing) show a resistance in rise of temperature of from twenty-five to fifty per cent below that allowed.

In the matter of construction special attention is given to the points of contact. Each switch is individually inspected by experts for that sole purpose.

When these facts are duly considered, as well as the substantial proportions of all material used, it does not seem surprising that Trumbull switches will carry a fifty per cent overload without injury.

This company advertises to make more individual switches than any other manufacturer in the country. Their Coast trade is very large. Not long ago they shipped a carload of switches to San Francisco.

In spite of contrary claims, the Trumbull people strongly deny that the manufacturing of switches is a "precarious business," providing, of course, that "the man knows how." As for themselves, they are to double their factory this year.

Their catalogue and literature will be freely supplied upon application.

NEWS NOTES

ELECTRIC RAILWAYS.

Boise, Ida.—The Boise & Interurban Electric Ry. Co. announces that its line between this place and Caldwell will be in operation by May 1.

Everett, Wash.—The Puget Sound, Skykomish & Eastern Ry. has applied to commissioners for franchise for an electric railroad and for telephone, telegraph, electric light and power lines. The electric road is to be built a distance of ten miles from Index to Galena.

Portland, Ore.—Actual construction work upon the United Railway Co.'s system is expected to begin in about ten days. L. B. Wickersham, constructing engineer.

Springfield, Ore.—Surveyor Klovdahl and crew are making a survey for the Willamette Valley Co.'s electric line from here up the McKenzie.

Seattle, Wash.—The Index & Northern Railroad Co. (capital $1,000,000) has been incorporated by C. F. Naething, of New York, John S. Jurey and T. E. Ellis, of this city. The object is to construct an electric line from Index to Mineral City, a distance of sixteen miles.

Boise, Ida.—New tracks throughout the entire length of the city trolley system on the Main, Thirteenth and Eastman Street line, and the Eighth and Ninth Street lines will be laid this Spring by the Boise Traction Company.

Bellingham, Wash.—Plans are under preparation by the special interurban railway committee of the South Bellingham Industrial Club, providing for a route of the interurban by way of Tenth Street to South Elk Street, where connection could be made with the Whatcom County Railway and Light Company system. The plans will be submitted to Stone & Webster, who will build the interurban this year.

Colfax, Wash.—It is reported that the Spokane Inland Electric Line are negotiating with the O. R. & N. Co. for their branch line, called the Moscow-Colfax branch.

Calgary, Alta.—Council has decided to build a municipal street railway system twelve miles long with equipment of twelve cars. W. L. Thorold, city engineer.

Everett, Wash.—The Puget Sound, Skykomish & Eastern Ry. Co., capital $500,000, has been incorporated by Nicholas Rudebeck, E. H. Guie and S. P. Ecki.

Helena, Mont.—Two hundred and forty thousand dollars has been subscribed toward the building of an electric line from Butte to Helena and thirteen miles beyond to the shores of Lake Hauser by F. A. Heinze, of Butte, and others.

Seattle, Wash.—A franchise for an electric railway to run around the shore line of the Duwamish River, commencing at Alki Point, and trestling bridges across the different waterways, has been granted to the Seattle Electric Co. by the King County board of commissioners.

Portland, Ore.—Articles of incorporation have been filed for the Mount Hood Ry. & Power Co., with a capital of $5,000,000, by E. P. Clark, R. T. Linney, S. B. Cobb and C. W. Miller.

Oakland, Cal.—A mortgage has been placed on record whereby the Oakland Traction Company mortgages to the Union Trust Company all its holdings, including real property, rolling stock, tracks and franchises. The mortgage is given to secure a bond issue of $12,000,000 which the trust company has underwritten. The bonds are to bear interest at the rate of five per cent., and are to run twenty-eight years. The Oakland Traction Company was incorporated November 7th last year, being a consolidation of the Traction Consolidated and other street railway companies. The Oakland Traction Consolidated had a bonded indebtedness of $7,000,000, which is taken up in the new issue. Much of the new debt will be used to extend the street railway system of the Oakland Traction Company.

POWER AND LIGHT PLANTS.

Calgary, Alta.—The proposition made by Messrs. Alexander & Budd to supply the city with electricity for power and light has been rejected and the city has made application to develop power at Kananaskis Falls.

Klamath Falls, Ore.—C. S. & R. S. Moore are planning to erect a large power plant on the Link River.

Oneida, Wash.—The Pacific Coast Gas & Oil Co., capital $300,000, has been incorporated by Alexander Sweek and Richard A. Wade, of Portland, Clayton L. Barber and John Nelson, of this place.

Tacoma, Wash.—Manager E. J. Felt, of the Pacific Traction Company, announced that his firm would, in a short time, begin the erection of a 40,000-horsepower electric plant in or near Tacoma.

Weiser, Ida.—The installation of a direct-connected or belted is contemplated for the municipal electric lighting plant. W. J. Morehead is superintendent.

Walla Wall, Wash.—The Board of Directors of the Northwestern Corporation, a company recently organized with a capital stock of $5,000,000, to control a score of light and power plants in the Northwest, met here and effected a temporary organization. Isaac W. Anderson, of Spokane, was elected president; Cary M. Rader, vice-president, and Robert Allen, secretary and treasurer.

Albany, Ore.—The Sanitam Electric Co. is arranging for the construction of seven power canals along the North Sanitam River. Joseph M. Healy, of Oregon City, is interested.

Ballard, Wash.—The Ballard Electrical Construction Co., capital, $2,000, has been incorporated by F. F. Fisher, R. L. Fisher and Alexander Bronk.

Portland, Ore.—The Portland General Electric Co. has been granted a franchise for a steam heating plant to cost about $300,000.

Portland, Ore.—A second power plant duplicating the Cazadero plant at Station A will be erected by the Portland Railway, Light & Power Co. on the upper Clackamas. The new plant will have a capacity of 25,000 horsepower.

TELEGRAPH AND TELEPHONES.

Spokane, Wash.—The Interstate Telephone Company, operating lines from Spokane into the Idaho panhandle, will extend its lines from St. Joe, at the head of navigation, twenty-five miles along the proposed route of the Milwaukee Railroad, and work will begin in a short time. M. A. Phelps, president of the company, said:

"It is the purpose to extend our service along the right of way of the new road, and we will begin work as soon as possible. We are now working on our new exchange at Coeur d'Alene, where the big switchboard is being installed. We are also stringing 5,000 feet of cable in Spokane."

Spokane, Wash.—A movement is being discussed at Colville, Wash., north of Spokane, to consolidate all the independent telephone lines in Stevens County, establish exchanges at Chewelah, Colville, Marcus and at Northport, extend short lines to contiguous points along the route of main lines and give an all-night or continuous service, and a rental rate to all subscribers to exclude any toll through the exchange. In exchange for the franchise privileges on the public highways, all county business will be handled free.

Spokane, Wash.—Stockholders of the Potlatch Farmers' Telephone Company, at Leland, decided at a recent meeting to connect with the Potlatch telephone line, of which R. H. Porter, of Juliaetta, Ida., is manager. This action is considered the most important move in the history of the company. The line has eighteen subscribers, but when the connection is made they will have communication with more than 150 farmers surrounding Juliaetta, Kendrick and Cameron, as well as with all long-distance points.

Spokane, Wash.—The council of St. Johns, Ore., south of Spokane, has granted a franchise to the Home Telephone Company for twenty-five years. The company will pay the city $5,000, at the rate of $200 annually, after the company installs its plant. It has eighteen months to put the line in operation. The other considerations are free telephones for the city, underground wires in the business section, and such other regulations as the city attorney insisted on for the protection of the city's interests. The petition for franchise by the Pacific States Telephone Company has not been considered.

Spokane, Wash.—W. F. Nobbins, of Wallace, Ida., east of Spokane, has entered suit in the district court there to recover $1,989.44 from the Rocky Mountain (Bell) Telephone Company for injuries sustained while stringing a line to Burke, June 2, 1905. It is set out in the complaint that he came into contact with a high-power line operated by the Washington Water Power Company, which was close to the telephone company's wires. He alleges the company agreed to pay him $3.25 a day while incapacitated, but did not pay more than $121. He asks $1,594.44 for wages and $390 for hospital expenses.

Bellevue, Ida.—The Bell Tel. Co. will erect a new exchange in the Spring.

Colville, Wash.—A movement is on foot to consolidate all the independent telephone lines in Stevens County, establishing exchanges at Chewelah, Colville, Marcus and at Northport.

Leland, Wash.—The Inter Farmers' Tel. Co. (capital $10,000) has been incorporated by J. H. Munn and William Bishop.

Moscow, Ida.—Thomas Elson, superintendent of construction of the Pacific States Tel. Co., is here making arrangements to install a new and up-to-date exchange.

Portland, Ore.—The Home Tel. Co. is laying pipes for underground lines on Grand Avenue.

Roseburg, Ore.—G. P. Mock, of the Pacific States Tel. Co., is here preparatory to installing a new central energy system. A complete cable system is also contemplated.

Spokane, Wash.—The Interstate Telephone Co., operating lines from Spokane into the Idaho panhandle, will extend its lines from St. Joe, at the head of navigation, twenty-five miles along the proposed route of the Milwaukee railroad, and work will begin in a short time. M. A. Phelps, president of the company.

St. Johns, Ore.—Council has granted a twenty-five-year franchise to the Home Tel. Co.

Phoenix, Ariz.—E. L. Bumpus, Arizona manager for the Pacific Wireless Telephone Co., states that the company will have stations in Phoenix, Tucson, Bisbee and Prescott within a year. The company owns its own manufacturing plants.

Oakland, Cal.—Electrician Babcock's request for an appropriation on $100 with which to buy cable, and $399 for labor and material in installing it, referred to City Council, with recommendation that it be granted.

Modesto, Cal.—W. H. Palmer has asked the Board of Supervisors for permission to erect a telephone line along the Dry Creek, and the Board has granted the petition, providing that poles be of sufficient height to keep wires above any road traffic.

INCORPORATIONS.

Sacramento.—Articles of incorporation of the Vallejo and Northern Railway Co. have been filed with Secretary of State Curry. This action has been expected for several weeks, as it has been persistently reported that such a company was to be formed for the purpose of constructing an electric line between Vallejo and Sacramento. It was known that Melville Dozier, Jr., of Oakland, headed the new corporation, but nothing definite as to his intentions has been known outside of rumor. The articles declare that the Vallejo and Northern Railway Co. is formed for the purpose of establishing a steam or electric line with Sacramento and Vallejo as the terminal points. The directors and projectors of the movement are: Melville Dozier, Jr., George S. Kakie, C. Francis Kinsey, and John C. Veitch, of Oakland, and T. T. C. Gregory, of Suisun. It is the intention of the company to begin its line at Woodland, run it thence in a general southwesterly direction to and through Winters, then south through Vacaville, and thence in the southwesterly direction to Napa Junction. Then beginning at a point between Vacaville and Fairfield, at or near the town of Cement, the line will run into Sacramento. The entire distance covered will be 105 miles. The capital stock is given as $2,500,000, of which $105,000 is already subscribed.

Los Angeles, Cal.—The Home Gas Company has been incorporated with a capital stock of $6,000,000 by W. S. Phipps of Pittsburg, Pa.; W. M. Hiatt, Edmund Mitchell, E. M. Selby, W. Z. McDonald, John Telfer, R. O'Neal, R. H. and E. B. Burton.

Los Angeles, Cal.—The National Electric Company has been incorporated with a capital stock of $25,000 by E. A. Tucker, I. V. Dempsey, H. E. and L. B. Yockey.

San Francisco.—The Wonder Water Co. has been incorporated with a capital stock of $1,000,000, by W. Dorn, W. A. Starr, J. T. Overburn, A. L. and R. Chickering.

San Francisco.—The Big Creek Light and Power Co. has been incorporated with a capital stock of $500,000, by Leo. H. Sussman, M. W. Pryor, Joe Hafer, Jr., Walter J. McLean and Jos. C. Love.

San Francisco.—The Ocean Shore and Eastern Railroad Co. has been incorporated with a capital stock of $3,000,000, subscribed $20,000, by J. D. Harvey, J. A. Folger, Charles Carpy, C. C. Moore and Burke Corbett.

Fresno.—The Coalinga Enterprise Oil Co. has been incorporated with a capital stock of $300,000, by T. A. O'Connell, S. A. Guiberson, Jr., S. R. Bowen, R. W. Dalles, and J. F. Lucey.

Sierra Madre.—The Home Telephone and Telegraph Co., of Sierra Madre, has been incorporated with a capital stock of $50,000, by Charles Kersting, W. E. Ferman, F. M. Hawes, H. Iver Thomas and J. M. Baldwin.

TRANSPORTATION.

Sacramento.—Attorney Arthur L. Seymour, representing the Northern Electric Railway Co., has filed suit in the Yolo County courts at Woodland seeking to condemn a strip of land belonging to Abbie B. Reed, containing 144.36 acres, and being situated along the Sacramento River, on the Yolo side, beginning at a point opposite a point between M and N streets, and extending thence along the river to a point nearly opposite a point between O and P streets. The Northern Electric Co. wishes to acquire the land on which to establish the terminals and yards of the new road, which will enter Sacramento in the near future, on 18th street, and will run to 7th and K streets, via D, 15th, I and 7th streets.

Redlands.—Following a meeting of persons interested in the Chestnut and Dunn electric railway franchises recently purchased from the city for eleven miles of street railway on Colton, State, Sixth, Citrus, and Reservoir streets, a temporary organization of the Redlands and Yucaipe Electric Railway Co. was effected; capitalization being placed at $1,000,000. C. S. Chestnut, George H. Dunn, O. D. Collins, O. M. Miller, and A. A. Moore are named as directors and incorporators, and have subscribed $18,000 of the capital stock. Articles of incorporation were filed at San Bernardino. The promoters claim that several persons of financial ability are interested and that the road will be built if the right of way is given free by ranchers in the valley. This has been promised, but deeds have not been given and cannot be until a survey is completed. This will require two weeks, and possibly longer, on account of snow. President Chestnut said that the route has not been definitely selected over the hills south of Redlands, but it is believed that the road will go out Reservoir street and through the canyon to the Yucaipe bench lands and thence on a direct line to the Oak Glen mountain resort, eighteen miles from Redlands.

Stockton.—Colonel W. R. Johnson, of the Central California Traction Co. and the American River Electric Co., says: "We expect to be running interurban cars into Lodi by April 1st." The two companies are separate corporations, but the majority of the stockholders in each are the same men and the same men are officials in each company. Colonel Johnson stated that the rails and ties for the road from this city to Lodi are on the ground and that the cars will be here before April 1st. Lewis Moreing has been awarded the contract for doing all of the grading and concrete work. The new cars for the company are practically finished. Several of them are ready for shipment, and the remainder are in the paint shops. All will arrive before April 1st, and it will require but a few days to mount them on their trucks and motors. Five of the cars will be for use in Stockton alone, and will be duplicates of the cars now used by the company in this city. There will be four passenger coaches. In addition to them there will be a number of freight cars, combination baggage, express and smoking and motor cars to haul the freight trains.

Santa Cruz.—The Ocean Shore Railway surveyors are in Soquel mapping out the route for a continuation of the line that is to connect Soquel with San Francisco, nearby towns and the San Joaquin Valley.

San Jose.—As the culmination of a series of complaints from merchants, citizens and various local organizations, the Mayor and City Council have notified George L. Berker, manager of the San Jose Street Railway Co., that unless summary action is taken by the company to rehabilitate its entire system, steps will be taken to revoke its franchise. The railroad company is owned by the Germania Bank and Trust Co., of San Francisco. An effort was made by L. E. Hanchette, of San Francisco, some weeks ago to purchase the line for $500,000, but the offer was rejected, the company holding out for $750,000. The claim is made that the company is holding up the city in the hope of securing a large price for the property. Hanchette has applied for franchises paralleling all of its tracks.

Alameda.—A representative of F. M. Greenwood has announced that Greenwood would start work on his proposed electric line through Alameda inside of two weeks. For several days Greenwood's agents have been taking up old options and securing new ones. At one time, after the fire, it was quite generally believed that Greenwood would abandon his franchise, but it is now announced that the road will be built.

TRANSMISSION.

Yreka.—By coupling its old power plant at Fall Creek with its new plant on Shasta River, the Siskiyou Power Co. established an interchangeable system, and can send out power from either or both sources. The Fall Creek plant produces 26,000 volts, and the Shasta River plant 6,500 volts.

San Francisco.—The Monterey County Gas and Electric Co., which owns and operates the electric car lines running from the Hotel del Monte to Pacific Grove, through Monterey, is remodeling its electric power plant at Monterey. It is now in the market for a 1,500-kilowatt turbo-generator to supply the increased power that will be needed when the electric road is extended to Salinas. George Heazelton, Kohl Building, San Francisco, is one of the new owners. He says the company has no connection with the projected Monterey, Fresno and Eastern Railway.

WATER WORKS.

San Francisco.—Sealed bids will be received at office of Construction Quartermaster, 1080 North Point street, San Francisco, until 11 a. m., March 16th, for furnishing all material and labor and constructing a water distributing system, sewer system and a 200,000-gallon reinforced concrete reservoir at Fort Berry, Cal.

Yuba City.—C. B. Andros, proprietor of the Yuba City Water Works, has purchased from Mrs. A. E. Davis a lot in the Copper Tract facing Bridge street, and located just south of the site of the proposed depot for the Northern Electric. Mr. Andros will take steps at once to sink wells to supply water for his big standpipe tanks, which he will erect on the lot.

ILLUMINATION.

Lakeport.—M. Wambold, of the Lake County Paraffine Oil and Gas Co., reports that a strong flow of natural gas has been developed in the new well which he is sinking for the company, much stronger than any which he has encountered heretofore. The well is perfectly dry, and the flow of gas surpasses in quality and quantity anything developed previously. Already the company has developed sufficient gas to get up steam for a standard rig. As soon as well No. 2 is completed a third well will go down, and then the three will be connected and the gas confined to one feed pipe.

Fresno, Cal.—The Western Gas and Power Co., of Oakland, submitted an offer of installing a complete gas plant at the county hospital and the almshouse for $1,465.50, at a meeting held recently by the Board of Supervisors. J. H. Becker, manager of the Western Gas and Power Co., and M. P. Holland, representative of the company in this city, presented the proposition of installing of a gas plant at the county hospital and almshouse. They offered to install a 1,000-light gas generator, with capacity of 4,000 cubic feet of gas per hour, complete for $1,000 on a trial of thirty days. This includes all the necessary labor and material connected with the plant. The company also agreed for $465.50 extra, to install necessary 50-candle power lights, an 8-R. W. Rood automatic water heater, 3 gas plates, all the necessary mains running into the hospital and almshouse. The proposition of the company was referred to the hospital committee for report at next meeting.

Redlands.—T. H. Sharless has moved to Perris from Redlands, and is at present working on a plan for a stock company to install an electric light plant and modern water system.

ENGINEERING.

Spokane, Wash.—The Hayden-Coeur d'Alene Irrigation Co., capital $150,000, has been incorporated by William C. Malloy, John S. Malloy and H. P. Blanchard.

Arlington, Ore.—Manager J. A. Smith, of the Baker Irrigation Co., has commenced work on a large reservoir north of the city.

Astoria, Ore.—Preliminary work on the government jetty at the mouth of the Columbia River has been started by Colonel S. C. Roessler. A parallel trestle two and one-half miles in length is being built between Fort Stevens and the sands.

Blackfoot, Ida.—The Lost River Construction Co. has been awarded the contract by the Big Lost River Land & Irrigation Co. for the construction of the necessary irrigation works to reclaim 80,000 acres of the Carey land in the Lost River Valley.

Great Falls, Mont.—Bids are asked by the U. S. reclamation service until April 3 for constructing twelve miles of main canal, sixty-seven miles of laterals and seventeen miles of waste water ditches. The work consists of 481,000 cubic yards of excavation, 1,200 cubic yards of concrete, 20,000 B. M. of lumber, and placing 182,000 pounds of steel.

Milner, Ida.—Sealed proposals will be received at this office until March 12, 1907, for the excavation of four miles of canal containing about 93,000 cubic yards of lava rock excavation, 470,000 cubic yards of earth excavation, 32,000 cubic yards of puddle embankment, 4,500 cubic yards of concrete work, 8,000 cubic yards of loose rock excavation; also forty miles of small canals and laterals containing about 260,000 cubic yards of earth excavation. Twin Falls North Side Land & Water Co.; by Paul S. A. Bickel, chief engineer.

Boise, Idaho.—Work on the big north side irrigation project on the Twin Falls tract is to be begun the first week in March. It is stated that $2,500,000 will be expended on the project and at the rate of about $100,000 per month. The system is to be installed by the Twin Falls North Side Land & Water Company.

Seattle, Wash.—Major H. M. Chittenden stated that surveying parties are working on the Duwamish, Puyallup and White rivers in the preliminary labors introductory to the engineering operations, which they are expected to make for the prevention of floods.

Vancouver, B. C.—It is proposed to dredge Coal Harbor beyond the bridge to Stanley Park.

Victoria, B. C.—It is reported that the C. P. R. R. will dredge the mouth of Victoria harbor.

OIL.

Santa Cruz.—Col. E. J. Bean, after many months of negotiation, early in 1906 secured oil options on about 50,000 acres of land up the coast, including the Swiss ranches and others. The petroleum outcroppings on the Enright ranch, following the cut made by the Ocean Shore Railroad in grading, were so profuse that it has been decided at once to bore an experimental well on the upper Enright ranch. Mr. Enright has the contract to grade a road to the proposed well site.

San Luis Obispo, Cal.—The report comes from Orcutt that the Standard Oil Co. is buying oil only upon its existing contracts, taking no excess from any company. Its pipe line has a capacity of 25,000 barrels a day, but the company is taking only about 4,000 barrels a day from that field. Six of its eight oil tanks are empty, each of them having a capacity of 35,000 barrels, but it is expected better conditions will shortly prevail.

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FINANCIAL.

San Francisco.—The new issue of Pacific Telephone and Telegraph first 5's were listed this week on the San Francisco Stock and Bond Exchange. The bonds issued and listed at this time amount to $3,000,000, dated January 2, 1907, due January 2, 1937, callable after January 1, 1922. The Pacific Telephone and Telegraph Co. has also issued $18,000,000 preferred and $18,000,000 common stock, of which the preferred represents cash invested in the property. This company now controls the entire Bell telephone system on the Pacific Coast, including the States of Washington, Oregon and California, with branches into British Columbia, Idaho, Nevada, and Arizona. Earnings for the calendar year 1907 are officially given as follows:

Gross revenue	$7,982,520
Op. expenses and maintenance	6,144,753
Net earnings	1,837,767
Interest	383,144
Surplus for dividends	1,464,623

The earnings for 1906 showed a decrease of about $300,000 as compared with 1905, on account of the conditions arising from the April fire in San Francisco, but as indicated they still show a large surplus after the payment of interest and of dividends on outstanding stock.

San Francisco.—The Monterey County Gas and Electric Co. has levied an assessment of $10 per share, delinquent March 16th, sale day April 9th.

Fresno.—The Kern Canon Oil Co. has levied an assessment of ½ cent per share, delinquent February 5th, sale day March 20th.

Visalia.—The Lindsay Heights Water Co. has levied an assessment of $2.50 per share, delinquent February 18th, sale day March 9th.

Cody, Wyo.—The secretary of the interior has awarded to the New Jersey Foundry & Machine Co., New York, the contract for furnishing high-pressure gates for Shoshone and Pathfinder Dams at $123,500.

CLASSIFIED LIST OF ADVERTISERS—CONTINUED

FINANCIAL.

San Francisco.—The companies supplying the city with gas and electric light have submitted statements to the Supervisors showing their receipts and expenditures, value of plants, outstanding stocks, bonds, etc., the net results for the year showing a loss, due to the fire. These filings will be taken up by the Board's meeting on Saturday to fix rates for the next year. The San Francisco Gas and Electric Co. stated its receipts for gas as $1,899,824.04; for electric light, $1,521,033.09; from other sources, $209,113.77. The "costs" were, respectively, $2,202,981.47 and $2,069,256.14, giving a "net loss" of $642,256.72. For the Coke and Gas Co. the revenue stated was $49,060.65, and the expenses $177,778.79. For the Mutual Electric Light Co., respectively, $71,281.42 and $53,396.97.

San Francisco.—T. G. Hart states that the sale has been completed of the Oil City Petroleum and Twenty-eight Oil Companies for $855,000, to W. M. Hall, supposed to represent the Standard Oil Co.

Eureka.—Annual reports of the different water companies of the county came before the Board of Supervisors last week. That of the Riverside Water Works, of Ferndale, showed that the plant is now worth $10,577.30. Last year the expenses were $300, and $889.20 were taken in, giving a profit of $580.20. Mrs. Ella Trumble, proprietor of the Hose Avenue Water System, situated near Fortuna, reported that for the year 1906 her receipts had been $294 and her expenses $99, the profit being $195. A petition was received from the Rio Dell Water Co., asking for a franchise to sell water, and lay pipe in the town of Rio Dell, in Humboldt County, and asking that the Board fix rates to be charged for said water. The petition was signed by Denver Sevier, A. A. Curtis, J. A. Sinclair, Ida H. Sevier, and C. H. Kinsey.

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The Engineers', Architects' and Builders' News

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THE

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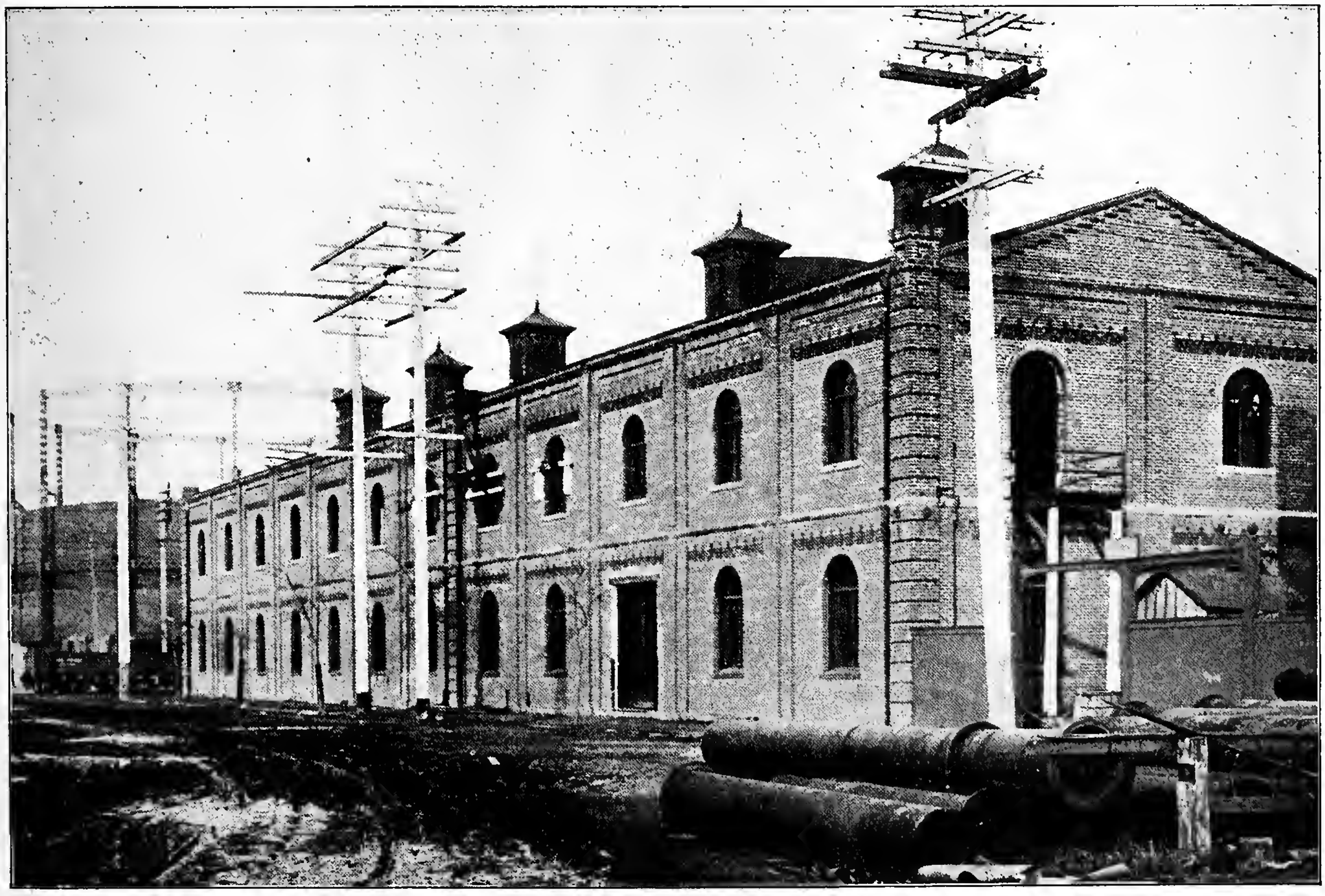
WITH WHICH IS INCORPORATED

The Engineers' Architects' and Builders' News

VOLUME XVIII. SAN FRANCISCO, CAL., MARCH 16, 1907 No. 11

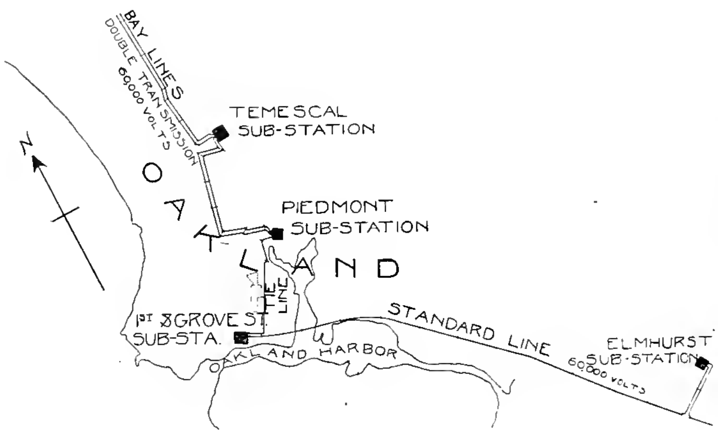
The Distribution of Electric Power in Oakland, Berkeley and Piedmont

In common with many towns and cities situated near San Francisco Bay, Oakland, Berkeley and Piedmont, which, though politically separate, are virtually parts of a single city of about 250,000 inhabitants, receive the greater part of the electrical energy which they consume over the long-transmission lines running from the western slopes of the Sierra Nevada Mountains. The standard line of the California Gas and Electric Corporation, which transmits from the hydro-electric station at Electra, in Amador County, about 175 miles distant, enters the City of Oakland from the southeast, after passing through the sub-station at Elmhurst. This is shown in the accompanying sketch. The double bay line of the same corporation, commonly known as the Bay Counties Line, comes in direct from the south tower of the suspension across the Carquinez Straits, over which the wires hang between supporting towers 4,427 feet apart. This line is fed by the station at Colgate, in Yuba County, about 141 miles distant, and the De Sablo station, in Butte County, about 190 miles from Oakland. By means of the "Tie Line," shown in the sketch, the Standard line and the two Bay Lines, may be operated in parallel, as is frequently done; or, should one of the lines be out of order, the sub-stations can operate from the other two. Power from all three lines is received at 60,000 volts.



MAIN BUILDING, FIRST AND GROVE SUB-STATION, AND ONE OF THE GAS HOLDERS OF THE OAKLAND GAS, LIGHT AND HEAT COMPANY

The largest of the sub-stations is at the corner of First and Grove streets, being operated in connection with the auxiliary steam plant of the Oakland Gas, Light and Heat Co.



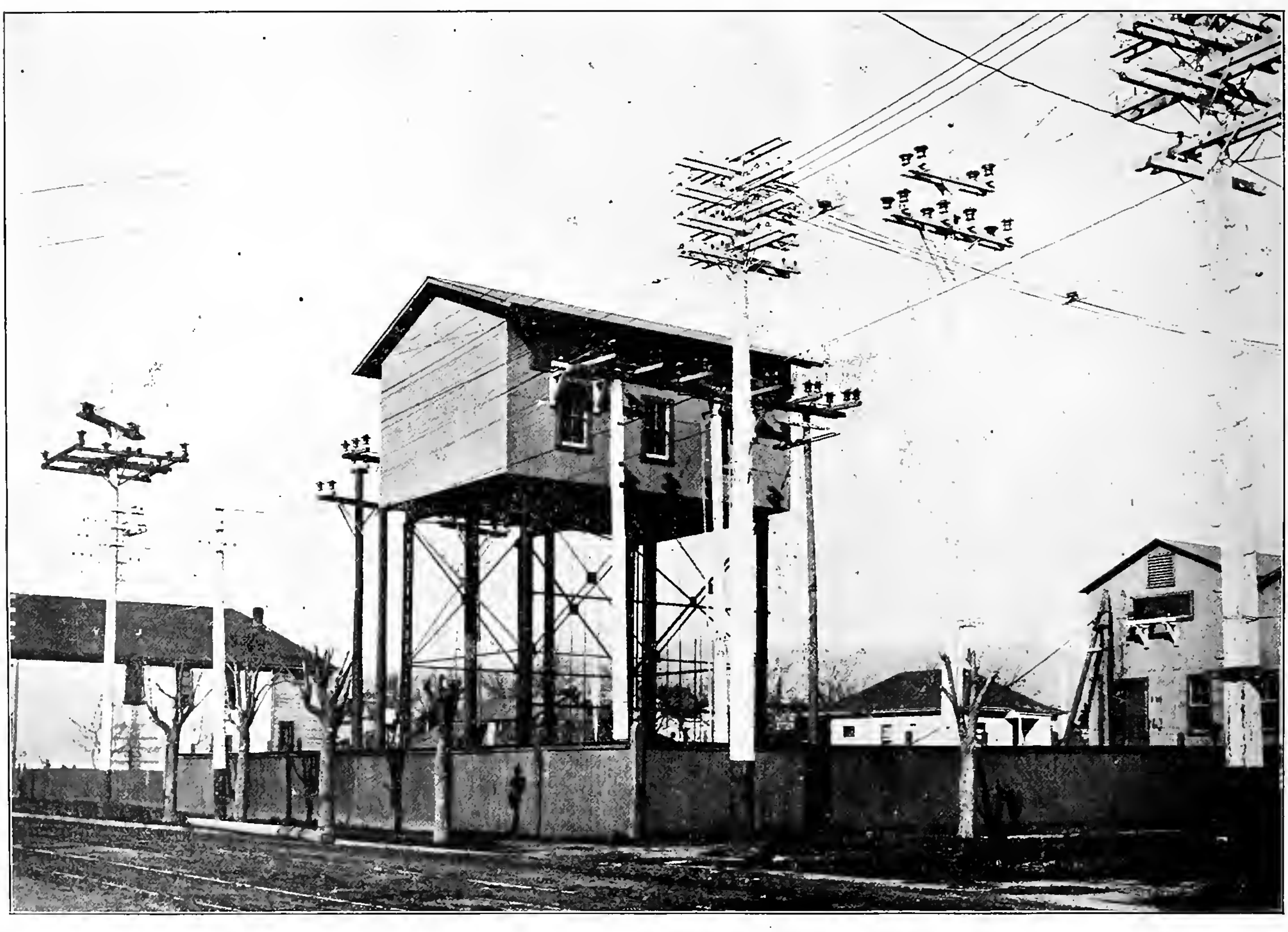
STANDARD AND BAY COUNTIES LINES AS THEY ENTER OAKLAND SHOWING TIE LINES

This plant, running continuously, takes care of the excess of the load over the capacity of the various transmission lines. Steam is generated by two batteries of return-flue, tubular boilers at 110 pounds pressure without superheat and by four Altman-Taylor boilers placed in sets of two. These have superheaters and supply steam at 150 pounds, with a normal rating of 250 horsepower each. The furnaces, of course, are all oil-burning. The fuel oil is stored in a riveted steel tank having a capacity of 5,000 barrels. This tank is placed entirely above ground, and the oil runs by gravity to the pumps, which belong to the Snow oil pumping system. By-passes are provided around the pumps so that if the oil is warm enough to flow it is possible to feed the boiler furnaces by gravity.

The engine equipment consists of a large Ballwood-Corliss vertical, cross-compound engine, direct-connected to a 750-kilowatt alternator. The cylinder dimensions are twenty-one and one-half inches and forty-five and one-half inches by twenty-four-inch stroke, with pressure in the receiver averaging about twenty pounds gauge. In addition to the above there is a McIntosh & Seymour 400-horsepower engine and a Hamilton Corliss of 500-kilowatt capacity. This latter is a horizontal tandem compound, twenty-two by forty-eight by forty-eight inches.

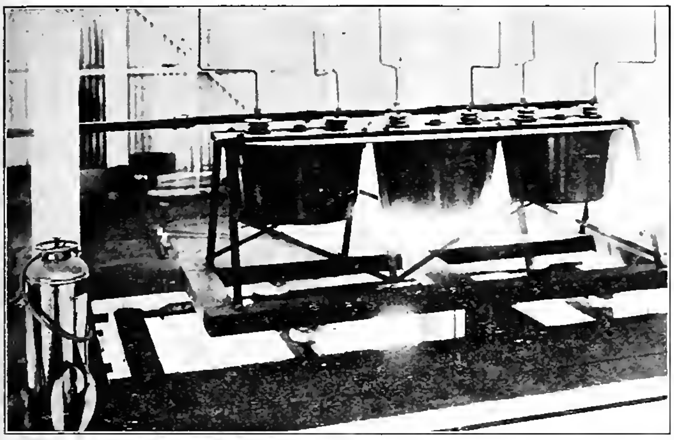
The system of lubrication is entirely automatic. The oil passes through a filter into a receiving tank from which it is pumped to separate gravity tanks for each engine. From these the oil flows through the bearings into another tank from which it is repumped to the filter and again sent through the same cycle. Two Worthington duplex, three by two by three-inch pumps operate this lubricating system, one pumping from the receiving tank to the gravity tanks and the other back to the filter.

The engines are all run condensing, as plenty of cooling water for the condensers is available, the plant being located in proximity to the Oakland estuary, an arm of the San Francisco Bay. When the tide is low, however, water can not be readily obtained without extending the suction pipe a considerable distance. To avoid this a system of storage has been devised. A large reservoir capable of holding about 1,250,000 gallons, has been constructed by enclosing a portion of the beach with wooden bulkheads. From these eight and



HIGH-TENSION SWITCHING TOWER, TEMESCAL SUB-STATION, SHOWING THE EXTERIOR AIR-BREAK SWITCHES.

ten-inch pipes run to the condensers, which are about 500 feet from the intake. By means of a number of gate valves water may be taken through the same pipes, either from the reservoirs or from the bay, as desired. On account of the large quantity of circulating water required, it is necessary to discharge back into the reservoirs, during low tide, where the water becomes cool again to a certain extent. As soon



ONE OF THE HIGH-TENSION OIL SWITCHES IN THE TRANSFORMER HOUSE, FIRST AND GROVE SUB-STATION.

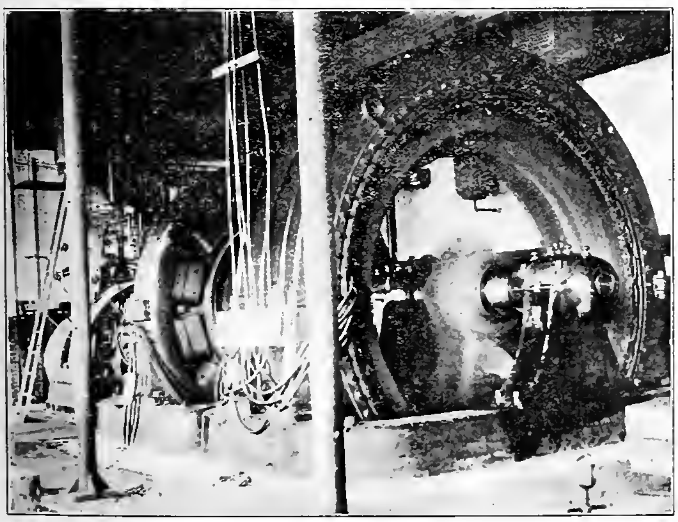
as the tide-water is high enough, however, the suction is changed from the reservoirs to the bay. The reservoir gates are opened, the warm water runs out, and the reservoirs are refilled by the incoming tide.

The water in the supply pipes is prevented from running out when the condenser pumps are stopped, by automatic foot valves. The end piece of each of the intake pipes is fitted in a stuffing box with a swivel joint, and is raised for cleaning by a chain and windlass.

The condensed steam from the surface condensers is pumped to the hot-well through trays of excelsior which catch the oil. The feed water is supplied from a fourteen-inch well 180 feet deep, the water being pumped by a Thomson and Evans deep-well pump.

Power is generated in this station at 2,300 volts, three-phase, by several large alternators either direct-connected to the prime movers mentioned above, or belted in some cases.

The distributing switch boards, three in number, are located on the second floor of the main building. There are twenty-seven panels in all, with all necessary recording and integrating instruments. The regulation of the distributing circuits is accomplished by seven General Electric hand regulators.



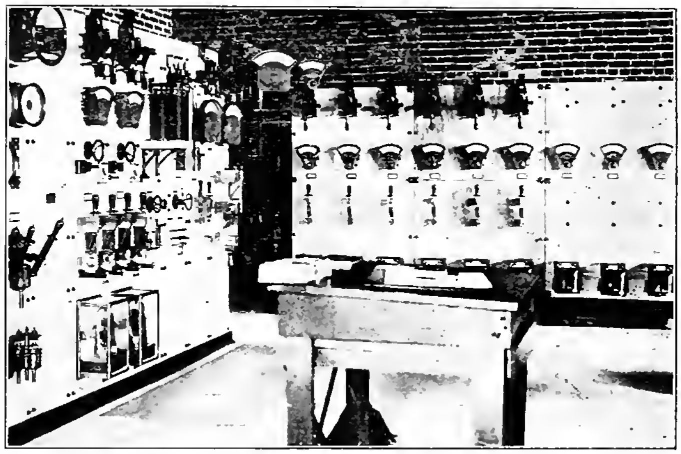
870 KILOWATT MOTOR-GENERATOR SET, FIRST AND GROVE STREETS SUB-STATION

On the same floor are also the constant-current transformers, the primaries being connected to 2,300-volt circuits. There are three 50-light and two 100-light oil-cooled regulating transformers, and four 50-light, air-cooled transformers.

The sub-station equipment connected with this plant is in a separate brick building adjoining the main station. A corrugated iron building is used exclusively for the high-tension transformers and oil switches. The air-break switches are situated outside of the building near the entry in accordance with the usual practice. Within the building, supported by a wooden gallery, are three sets of oil switches for controlling the Standard line, the Bay line and the two lines connected in parallel. The switches are operated from the main floor by hand levers.

The voltage is stepped down from 60,000 to 2,300 and 4,000 by six 1,000 kilowatt Stanley oil and water cooled transformers, one set being Y-connected and the other delta. In addition there are four similar transformers connected open delta for stepping up from 2,300 to 10,000 volts for transmission to large consumers situated some distance away.

In the main building are several synchronous motor-generator sets for producing continuous current at 575 volts for street railway and for elevator and general power work. The largest of these, a Stanley 870-kilowatt unit, was installed last May. The synchronous motor is a three-phase machine of the inductor type and operates at 2,300 volts. The con-



CORNER OF THE TEMESCAL SUB-STATION, SHOWING SEVERAL OF THE SWITCHBOARD PANELS.

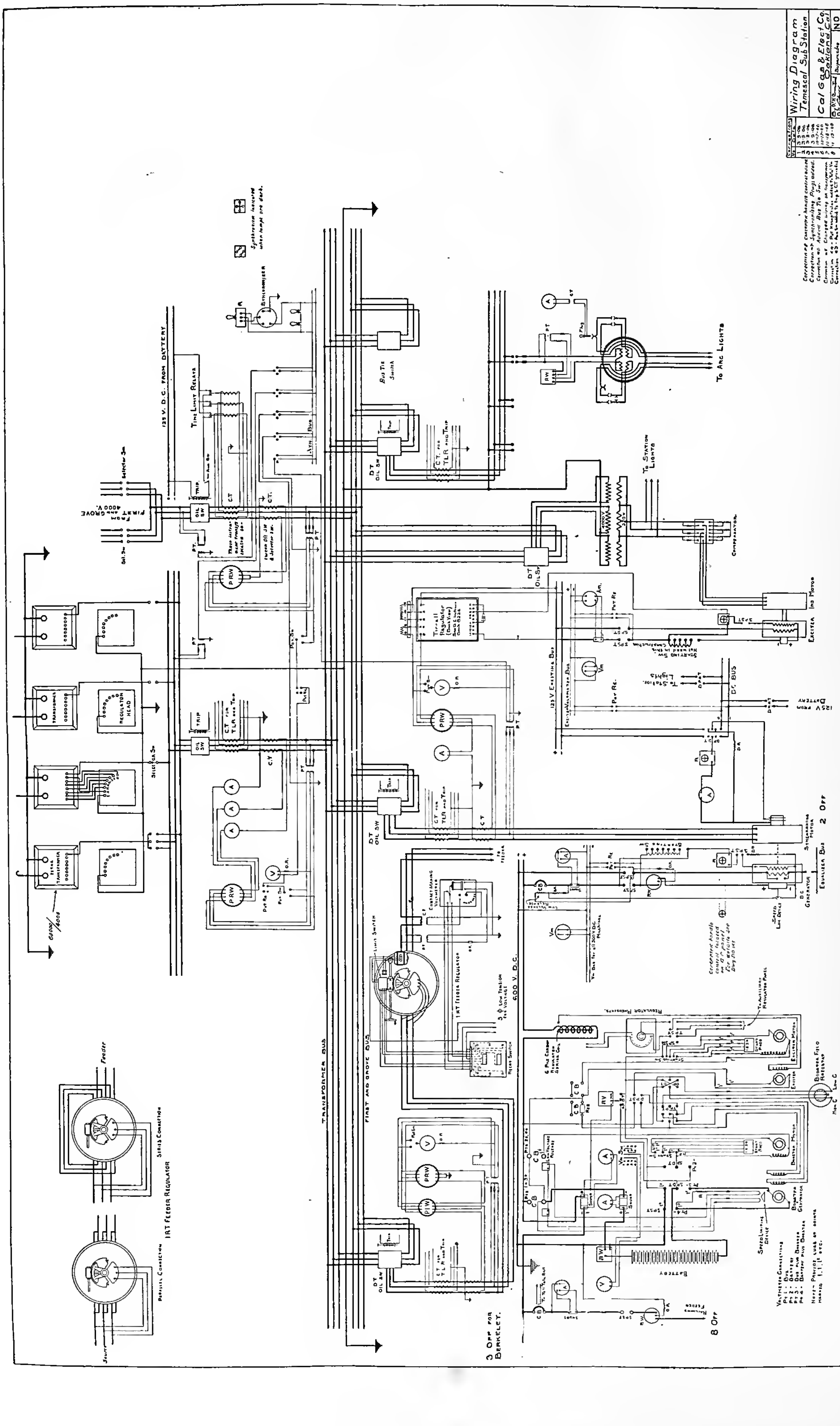
tinuous current generator is a 12-pole machine, direct connected thereto.

This station supplies South, Central and East Oakland, including the principal business district.

Berkeley, North Oakland, Piedmont and an emergency line to Point Richmond, which connects with the plant of the Standard Oil Company, and is to be used for fire purposes only, are supplied from the Temescal sub-station, situated on Fifty-first Street, near Telegraph Avenue. Several of the street car lines of the Oakland Traction Consolidated are also operated by power from this station. The building is of brick and corrugated iron, with large windows, which afford excellent light and ventilation. The eastern half of the building has but one story and is now used for the accommodation of the storage battery cells.

The western half, which consists of the sub-station proper, was built about a year ago and consists of the transformer and generator rooms. This floor is built over a high basement, which provides for all wiring and piping. The building of brick with concrete steel floors throughout. These floors are designed for a uniform load of 9,000 pounds per square foot.

The high tension transformers are 1,000 kilowatts each and are water cooled, each transformer being piped so as



WIRING STATION TEMESCAL SUB-STATION.

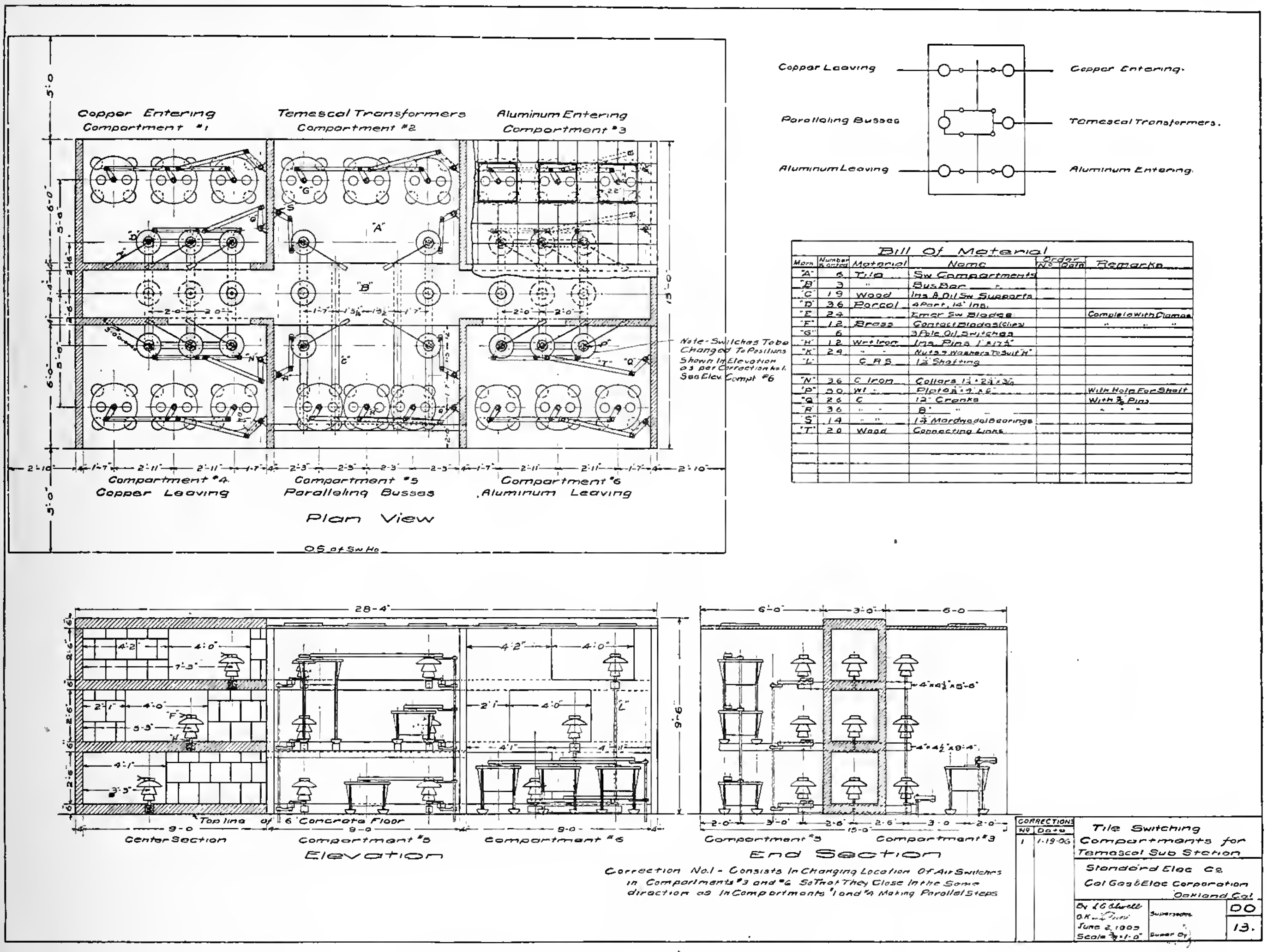


DIAGRAM OF SWITCHING TOWER.

to give independent regulation of the cooling water. Temperature gauges are placed on each transformer with an alarm attachment, which can be set to ring at any predetermined temperature. There are four transformers of this capacity, three connected in "Y," stepping the voltage down from 60,000 to 4,000 volts. The fourth is an emergency or spare transformer, being on hand and in place in case of any accident to one of the others. It has a high tension tap that can be connected to any leg of the high tension bus bars. While the secondary leads are provided with three selector switches by which it can be connected to any secondary legs. In case of accident to one of the regular transformers, service would be interrupted only long enough to make the high tension connection and to close the proper secondary switch. This arrangement is shown in the cut of the wiring diagram. Regulation is effected by means of a hand regulator head provided for each transformer with taps taken from the windings.

Between the generator room and transformer room is an 18-inch wall with opening for the doorway protected by an automatic closing, fire-proof roller door. This insures perfect isolation of a fire should one occur. The floor of the generator room is 8 inches higher than that of the transformer room as an additional fire protection to provide against oil from the transformers, possibly flowing into the generator room.

The equipment of the generator room consists of motor-generators, switchboards, etc., as shown in the acompanying illustrations. There are two 450-kilowatt motor generators of General Electric design. The motor is of synchronous revolving field type with stationary armature, wound for 2,300 volts delta, or 4,000 volts star, and designed for 60 cycles. The speed is 400 revolutions per minute. The generator supplies direct current for the street railway service at 575 volts. The machines are provided with automatic end play and runaway release devices, as well as low voltage release. They are guaranteed for 50 per cent overload for two hours without undue heating. An interesting feature is

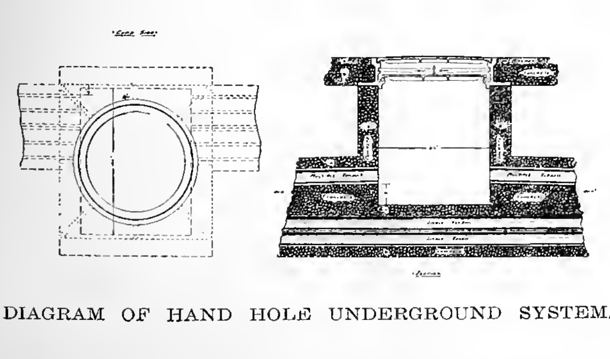


DIAGRAM OF HAND HOLE UNDERGROUND SYSTEM.

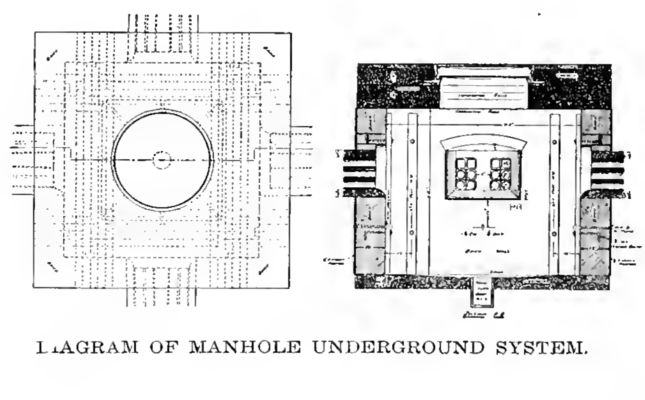


DIAGRAM OF MANHOLE UNDERGROUND SYSTEM.

which insulates for line voltage at all times but allows the excess voltage to go easily to earth, seems to be still a dream of the future, where high tension apparatus is to be protected. For low tension there are several excellent arresters.

For our 45,000-volt line we use the horn type or "Dutchman" arrester, using two gaps in series with a water resistance connected to earth. This resistance is made from a 2-inch fibre conduit, 30 feet long, supported vertically by cross-arm 7 feet apart down the pole. The terminal of the second gap dips into the top of this tube, while the bottom rests on the ground and is corked with a wooden ply through which an iron pipe enters. Water is turned into this until the water flows over the top enough to wash off all dust. In frosty weather more water may be allowed to flow to prevent freezing. The size and length of this tube is calculated from the measured resistance of Cedar River water and by dipping the wire at the top further into the water any desired resistance may be obtained.

Wire.

In choosing wire for inside station construction we have made several experiments on the various types of insulation, and use the following 600-volt rubber-covered for all potential and series transformer secondaries to instruments, both for open work and in conduit. In every case we ground one side of the transformer circuit, both at the transformer and at the switchboard. All lighting and motor circuits of 110 to 500 volts are, of course, operated on this grade of wire, 3,000-volt rubber-covered for all 2,200-volt work either open or in conduit. Sizes from No. 8 up have an additional layer of asbestos. All bus bars and taps from bus bars to switches being less protected in case of short circuit or arcs are given a heavy taping of asbestos cut in strips and soaked in sodium silicate solution. An outside wrapping of empire cloth holds this in place until it dries. When thoroughly dry we have found that an arc may start in the midst of heavy cables without spreading or causing damage except over a very small space.

Anything in the way of fire extinguishers is of necessity a failure in stopping an arc, as their object is to generate carbon dioxide and smother a flame for lack of a supply of oxygen. It is obvious, therefore, that an arc which does not depend on combustion is not affected but rather helped by the chemical used.

The choice of thoroughly fireproof covering of high dielectric strength on all important high voltage busses or wires is of vital importance. I prefer angle iron racks for supporting all wires in stations or sub-stations. The city sugstation at Seventh and Yesler Way has not a foot of wire supported on wood from the entrance of the current at 45,000 volts to the lowest voltage feeder. Iron gas pipe or angle iron supports are neat and substantial, and if any insulation should be faulty the arc has nothing to set on fire.

For outside work it is best to use nothing smaller than No. 6 B. & S. for voltages above 500, for mechanical strength.

The matter of insulation on arc circuits has given us trouble in various parts of the city. The action of these circuits on parallel telephone lines has been considerable in many places. In an alternating series system leakage is often worse than induction. We have taken out a great many knobs and small insulators, and so bettered the system, and will probably use a 10,000-volt glass insulator. The difference between the price of such an insulator and one of the deep groove railway type is a small item considering the better service.

Transformers.

In choosing transformers for lighting and power work the average engineer of a municipal plant has his hands full. The purchase is made after calling for bids, and the cheapest bid is usually the cheapest transformer, fit only for a scrap pile. Actual tests show that the makes run all the way from 3,500 or 4,000 lines to 10,000 lines and over per square centimeter. Only a few guarantees are reliable. We have guarantees that core type transformers will bank in with shell type of different regulation, and to prove the argument to be wrong, two transformers were connected by short, heavy leads. The one with the better regulation rapidly heats. This makes an easy test as to whether new transformers will bank in on the system with existing transformers. It is best to decide on one make and type of transformers, and if satisfactory, to hold to this type at all times. The transformer chosen for motor work should be liberally designed to allow for overloads.

It is doubtful if it is economical to use less than two and one-half or more than 25 kilowatt units on the average loads in a growing city like Seattle; 25 kilowatt is an easy transformer to place on a pole or platform, and is about right in business districts for load distribution, while the 50 kilowatt size is too large, and owing to the large busses in such a district, we cannot bank in other sizes without throwing the load on the larger sized transformer.

Lamps.

Lamps, like transformers, should be of one make and type throughout, so that any part of one lamp can replace the same part in a damaged lamp in either series or multiple type.

As there are to be several lectures on switchboard and machine practice and on transmission during the next two months, I shall leave the discussion of these until later.

ELECTRICAL WORK IN CUBA.

The electrical engineer, like Alexander of historic fame, is ever on the lookout for fresh fields to conquer. Unfortunately, the known territories of the world have been already mapped out for his exploitation; and as the limits of his capacity transcend by far the boundaries of the earth, he must concentrate his efforts upon the not unprofitable task of developing the applications of electricity in the countries into which it has gained an entry. Since Cuba was released from Spanish occupation, it has remained in the public eye rather as a hotbed of political disaffection and revolution than as a land of promise for the engineer, and our manufacturers are, in consequence, apt to overlook the possibilities which it affords. This is, however, an error into which our Transatlantic cousins are not likely to fall, for, with characteristic enterprise, American electrical engineers are doing their utmost to develop a market in Cuba. Already there is a first-class electric power plant in Havana, while there are also good power plants for the operation of the electric car lines, in addition to the telegraph and telephone lines. In view of the possibilities in Cuba, it will not be amiss if we refer to an article in a recent number of the "Western Electrician," giving an interesting account of the conditions under which electrical work is carried out in that country, and which affect linemen principally, as will be seen from the following quotation: "The clay," says the writer of the article referred to, "is a sticky substance which clings to your shoes and makes traveling hard. It makes it difficult to sink a pole. You have to exert considerable pressure to get the point started. Then the first thing you know the point strikes a hard substance. There you quit, for you have contacted with the hard coral stratum which prevails just below the surface of the earth. This coral stratum causes the trees to topple over in the event of high winds, as the roots cannot get down into the ground very deep. With the fall of the trees the wires always get broken and tangled." Another cause of trouble to electric linemen in Cuba is the premature decay of wood in the ground. "Poles are rotted off very quickly. The result is that steel poles are employed quite largely. Most of these metal poles are con-

structed of series of pieces, arranged in a tripod plan, extending upwards to the required height. The base of the pole is sunk into cement Many of the wood poles are likewise cemented up at the foot, and the cement prevents decaying of the lumber. First the hole is made in the ground and then the base or foundation cement is put in. This is allowed to harden a little while, and then the base of the pole is put in. When erect the cavity is filled with cement. When dry and hard, a very substantial foundation and support is obtained for the pole. Annoyances are experienced in regard to native labor. While the average Cuban is a better worker than the Filipino, he has his disadvantageous qualities. The natives eat a little bread and drink a little coffee in the morning. They expect to quit promptly at eleven o'clock for breakfast, just when you are getting interested in your work and want to keep on. The whole gang stops, and you cannot get a thing done until one o'clock. Then they work until six o'clock. The Cuban lineman is agile and willing. He can go up the poles well, and he can work if he wants to." It appears that some of the American soldiers in Cuba are already purchasing their discharges for the purpose of engaging in electrical work in the island. The planters are putting in more machinery. The electrical people are now placing orders for increased apparatus. More lights are being arranged for, and additional electric railway lines and the like are in progress. There is a better demand for electrically-operated machinery. Telegraph and telephone lines are being developed. There are without a doubt increased opportunities in Cuba for electrical manufacturers.

METHODS OF CREOSOTE ANALYSIS.

The growing scarcity of lumber, with the consequent high prices, is making it imperative that more attention be paid to preservative processes, whereby the time of service of timber may be lengthened. Coal-tar creosote is generally regarded as the most efficient of the wood preservatives. This product is very variable in composition, owing to differences in the coals used and in the methods employed in their distillation. Creosotes of different compositions are believed to have different values as wood preservatives, and an analysis of the oil used is, therefore, important.

No very large amount of study has been directed to perfecting the methods of creosote analysis, and the Forest Service, believing the matter vitally important to the progress of wood preservation, is now carrying on an investigation of these methods.

The most important part of a creosote analysis is the fractional distillation, since by this operation an approximate determination is made of the relative proportions of the most important substances in tar oil. There has been considerable divergence of opinion as to the best way of carrying out the fractionation of tar oils, some recommending a retort as a distilling vessel and certain temperatures for taking fractions, others recommending a distilling flask and a different set of temperatures.

Laboratory experiments, carried on by the Service, have shown that the difference in the weights of the fractions obtained when using different sorts of distilling vessels are not large, but that the composition of the fractions indicate a little better separation by the flask than by the retort. As regards the influence of the rate of distillation, variations of from one to three drops per second have but slight influence on the weights of the fractions, though the slower rate is more satisfactory.

It is commonly believed that the relative amounts of light oil, naphthalene, and anthracene oil are the most important factors determining the value of a creosote for wood preservation. A number of creosotes were very carefully fractioned and determinations made of the amounts of naphthalene and solid anthracene oil distilling between various temperatures. The average of the results shows that at least twenty-five per cent. of naphthalene was present in the distillate between 205 and 250 degrees C., and that over twenty-five per cent. of anthracene oil solids are present in the distillate above 300 degrees C. Work on the specific gravity and the index of refraction of the distillates between different temperatures is now being carried on.

The desirability of getting the criticisms and suggestions of users of creosote has led to the publication of a detailed account of the methods employed in the experiments and the results which have been obtained. Those who desire the publication should ask for Circular 80, Fractional Distillation of Coal Tar Creosote. Request should be made to the Forester, Forest Service, Washington, D. C.

UNDERWRITERS' NATIONAL ELECTRIC ASSOCIATION.

The annual meeting of the electrical committee of the Underwriters' National Electric Association will be held at the rooms of the New York Board of Fire Underwriters in New York, on March 27 and 28, for the purpose of making changes and additions to the national electric code. As is well known, it has always been the endeavor of the electrical committee to make only such changes in the code as are made necessary by progress in the art, or such as have been shown by some field experience to be necessary to safeguard against hazard, since changes in the code, even if necessary, cause more or less confusion and trouble. It will be remembered that at the last meeting of the electrical committee in December, 1905, there were submitted matters of such importance as to require further consideration before action was taken. These various matters were referred to sub-committees, by whom they were considered during the past year, and their reports will be considered by the full committee and finally brought before the general meeting in New York for action. The following committee reports will be considered: Committee on rules for signaling system; committee on slow-burning, weather-proof wire; committee on wiring and equipment of street railway property, including rolling stock; committee on double and single-pole switches; committee on variable-speed motors; committee on theater wiring; committee on construction and installation of rheostats; committee on series lamps; committee on insulating joints; committee on outlet boxes; committee on metal mouldings; committee on laboratory report in condulets; committee on rule 13A; committee on omitting fuses in neutral of three-wire systems, and committee on electric signs. There are also a number of suggested changes in the rules to be given consideration, as well as a number of miscellaneous suggestions.

WOMEN IN THE POSTAL SERVICE.

According to a report made by the United States postoffice department, Uncle Sam has 188 women assistant postmasters and 2,100 women employed as stamp, delivery window or money order clerks. The women clerks receive on an average $1,130 a year, or about $70 less than the men clerks. Two women employed in the postoffice department proper at Washington earn $1,800; sixteen receive $1,600; forty, $1,400; seventy-one, $1,200; and seventy-four, $1,000 per annum. A majority of these women are either wives or widows. The testimony of the postoffice authorities is that women make highly efficient public servants and that they are equal in honesty to men, if not superior to them.—"Weekly Bulletin."

TRANSFORMERS FOR MEASURING INSTRUMENTS.

Kenneth L. Curtis.

On looking over a large switchboard of modern design, one is at once struck by the uniform rows of measuring instruments. At first glance these instruments appear to be identical in every respect, and a close inspection shows that in external appearance they differ only in the lettering and figures on the scales. On examining the name plates we find that we have before us a variety of voltmeters, ammeters, wattmeters, powerfactor indicators, etc., and that the ranges of instruments of the same class vary from a few to many thousands of the units it is to measure. If we were to go farther and remove the cases from the instruments we would find that the similarity is not confined to them, and that the great majority of the instruments, the voltmeters and ammeters, are almost identical in all respects.

At some distance from these instruments are bus-bars and cables carrying currents of perhaps thousands of amperes at pressures of thousands of volts. Evidently these currents are too large to pass through the coils of any measuring instrument, and the pressures are higher than would be safe to apply to the leads of any instrument. In spite of these facts, the instruments on the switchboard indicate all of the electrical conditions of the cables and bus-bars in which we are practically interested. Although the greatest current flowing in any instrument lead is but a few amperes, we have an accurate indication of the voltages and currents and their phase positions of all of the circuits.

As is well known, all single quantity measuring instruments are inherently ammeters of very low range. In order that an instrument may measure pressures, the current flowing through its coil must vary directly with the voltage to be measured. The scale is then marked in volts. An instrument may be used to measure currents of any magnitude, provided the current actually passing through its coil is directly proportional to the current to be measured and the scale is marked accordingly. To indicate watts or powerfactors it is only necessary to combine current coils and pressure coils according to the usual construction of instruments for these purposes. A pressure coil is a coil carrying a small current whose magnitude is a measure of the pressure it represents. A current coil is a coil carrying a small current whose magnitude is a measure of the current it represents.

A pressure coil may receive its current through leads attached directly to the points between which the pressure is to be measured, provided the resistance of the coil is high enough to prevent too large a current flowing, and provided its inductance is low enough to prevent appreciable error due to difference in phase between the current and the pressure it represents. If the resistance of the coil itself is not large enough to fulfill the first requirement, a non-inductive resistance, called a multiplier, may be connected in series to keep the current within the range of the instrument. This arrangement is satisfactory for moderate voltages. At very high voltages it is not at all satisfactory, as the dangers attending the connection of instrument leads to the conductors of a high voltage system are obvious. In addition to the liability of the instrument being destroyed, there is the attending danger of injury to the switchboard attendants. The energy consumed at high voltages may also enter as a factor. The energy consumed by the instrument and its multiplier is proportional to the square of the voltage, and while very small at low voltages it would be by no means a negligible quantity at the high voltages now in common use.

A current coil may receive its current by attaching the leads to the terminals of a shunt resistance of low temperature coefficient, through which the current to be measured is flowing, provided the inductance of the coil does not introduce an appreciable error. This device also necessitates an electrical connection between the instrument coil and the conductors of the system with the attending dangers.

To avoid the dangers mentioned above, some means must be used that will give the desired result without necessitating an electrical connection between the instrument coils and the conductors of the system.

Fortunately the static transformer provides a means of producing in a secondary circuit at low current values and voltages an exact measure of what is taking place in the primary circuit. If the load on a transformer is very light, the secondary voltage per turn is almost identical with the voltage per turn in the primary, and the two windings may be separated from each other by any amount of insulating material desirable. Similarly the ampere turns of the secondary circuit are almost equal to those of the primary. Due to the resistance of the circuits, the leakage flux, and the necessary magnetizing current there will not be an absolute equality between the primary and secondary volts per turn, nor between the primary and secondary ampere turns, but the difference is small in either case, and may be compensated for by a change in the ratio of turns. Thus if a voltage ratio of 100:1 was desired and the ratio of turns of 100:1 should introduce an error of 1 per cent., the transformer should be wound with a ratio of turns of 99:1. To get a desired ratio of primary and secondary currents a similar change in the ratio of turns is made. The secondary ampere-turns are less than the primary ampere-turns, due to the magnetizing current in the latter. To get a given current in the secondary circuit, less turns are wound on the secondary coil than indicated by the rated ratio.

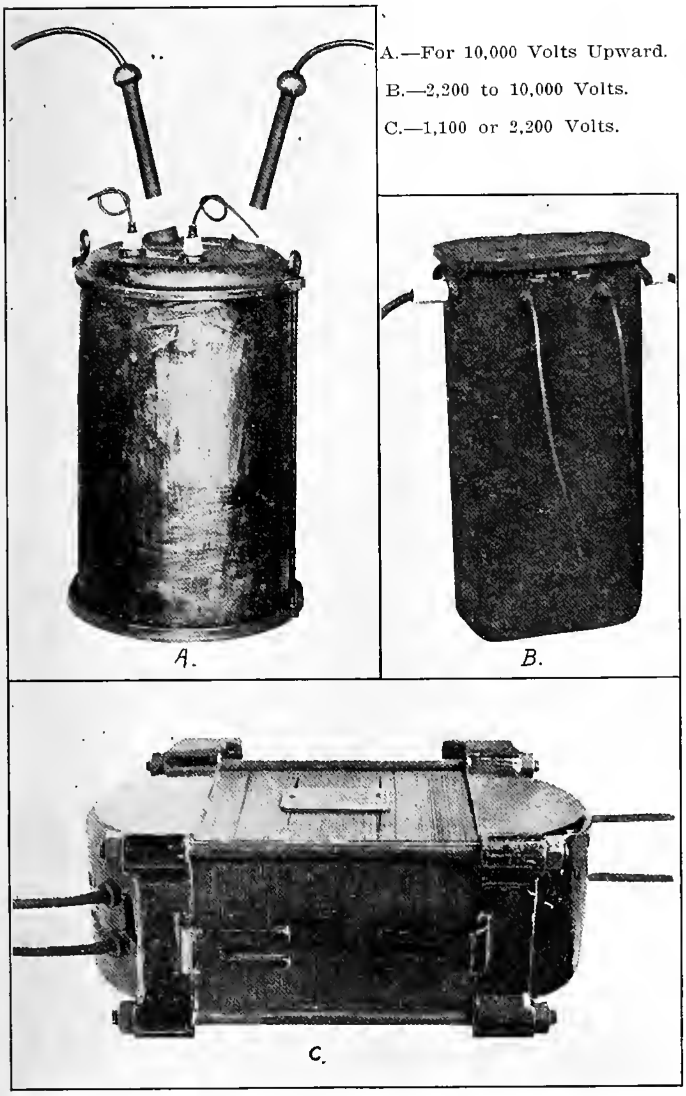
In alternating current practice the current and potential coils of the switch board instruments are used in conjunction with static transformers called current transformers and potential transformers. These transformers will be taken up and described separately.

Potential Transformers.

A potential transformer serves two purposes. It transforms the actual line pressure to a pressure within the range of the instrument employed. It serves to insulate the instrument from the line on which it is used. It closely resembles the familiar type of constant potential power transformer except in the case or mounting, and everything that enters into the design of the power transformer applies to the potential transformer. To prevent errors due to poor regulation the potential transformer is always large for its actual load, and hence cooling devices are unnecessary. As it is always located in a protected place, the enclosing case is noticeably light in construction. The iron, copper, and insulating material are arranged exactly as they would be in a power transformer of low capacity. As the total power taken by the potential transformer is very small, the efficiency is a secondary consideration. The chief point in the design is that of regulation. As stated before, a slight voltage drop may be compensated for by a change in the ratio of turns, but this is accurate for only one value of secondary resistance or load. Thus if a transformer of poor regulation gave the desired ratio when supplying the potential coils of three or four instruments, it would give too high a voltage if used on one instrument alone. For this reason the resistance and reactance of both the primary and secondary windings must be kept as low as possible. In using a potential transformer on the potential coil of a wattmeter it is necessary that the secondary current shall represent the phase position of the line voltage as well as its magnitude. This condition is never absolutely obtained under practical working conditions. The secondary current always leads with respect to the desired position, but the error thus introduced is so small as to be negligible.

The exact behavior of the potential transformer can be determined under any condition by applying the general theory of the alternating current transformer, which is too

well known to need reviewing here.* An idea of the magnitude of the quantities involved may be assisted by the following facts: In a well designed transformer on open circuit the secondary volts per turn are less than one-half of one per cent lower than the primary volts per turn. If the transformer is large enough so that the load furnished by the potential coils it supplies may be neglected its ratio will differ from the ratio of turns by less than one-half of one per cent. The current taken by each indicating instrument is about .04 ampere at a power factor so near unity that the wattless component may be neglected. Under ordinary working conditions the voltage to be measured will vary but a few per cent from the normal voltage of the system, and if the ratio of turns is adjusted to give the desired ratio at the normal voltage no appreciable error will be introduced at the greatest deviation from this value.



A.—For 10,000 Volts Upward.
B.—2,200 to 10,000 Volts.
C.—1,100 or 2,200 Volts.

FIG. 1.

The general appearance of potential transformers is shown in Fig. 1. The oil insulated types closely resemble power transformers.

Current Transformers.

A current transformer performs the same function with regard to current coils of measuring instruments that the potential transformer does with regard to potential coils. It transforms the current to a value suitable to the instrument, and at the same time insulates the instrument from the line. Like the potential transformer it has two windings surrounding an iron core, but beyond this it resembles the potential transformer neither in appearance nor design. As the entire line current flows through the primary winding, sufficient copper must be provided in this winding for the purpose, and the large primary terminals are the predominating feature in the appearance of the current transformer. Fig. 2 illustrates several types of current transformers. In its design it is not necessary to consider the primary resistance or reactance, as the accuracy of the transformer is in no way affected by the magnitude of these quantities. The secondary or instrument current depends only on the ampere-turns supplied by the primary winding which will have the same

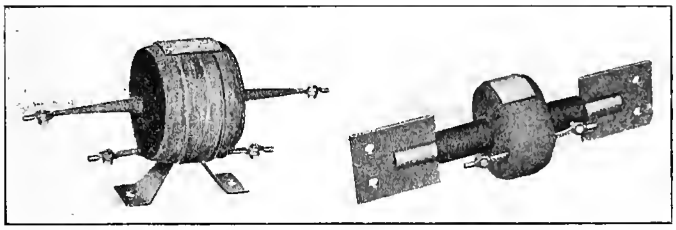
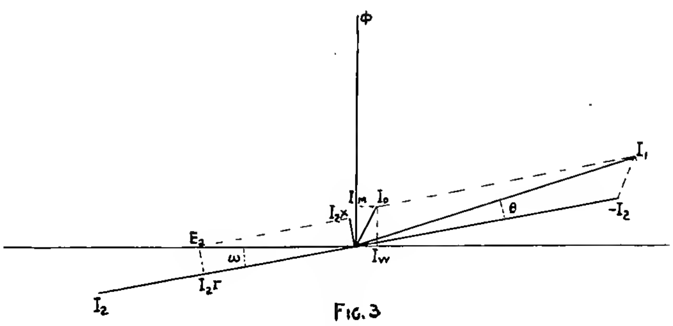


FIG. 2.

value regardless of the resistance or reactance of this winding. This fact is made use of in the location of the secondary winding and insulating material. To keep the secondary reactance as low as possible the secondary winding is placed next to the core. On top of this winding is placed the insulating material to protect the instrument from the line. This brings the primary winding some distance from the core and causes a comparatively high value of the primary reactance, which, as we have seen, has no bad effect. The secondary ampere-turns are less than the primary ampere-turns, due to the magnetizing current. The smaller the exciting ampere-turns in proportion to the total ampere-turns the more nearly accurate the transformer for all loads. This means that there must be plenty of iron in the core, and that it must be of good quality and well laminated. Under normal working conditions the values of flux density and the attending core heating are very low. If the instrument circuit should be opened when the primary is carrying current the active ampere-turns rise to the full primary value and the flux density and core heating rise to many times the normal working values. For this reason it is desirable that the secondary terminals of the transformer should be joined by a wire of low resistance when the instrument is removed from the circuit. In the earlier forms of current transformers a failure to take this precaution almost invariably resulted in the destuction of the transformer.

*The factors which enter the discussion of the current transformer are shown in the diagram, Fig. 3.



I_2 is the secondary current.

r and x are the resistance and reactance of the secondary circuit.

*See "The Alternating Current Transformer," F. G. Baum. "The Elements of Electrical Engineering," C. P. Steinmetz.

*Curtis, "The Current Transformer." Proceedings A. I. E. E., October, '06.

$E_2 = I_2 r + j\, I_2 x$ is the voltage generated in the secondary circuit.

ϕ is the total flux of the transformer. It is proportional to E_2 and is 90° ahead of E_2.

I_1 is the exciting current consisting of the wattless component I_M and the power component I_W.

$I_2 = I_0 + I_2$ is the total primary current.

ω is the angle between the secondary e. m. f. and current.

$$\cos w = \frac{r}{\sqrt{r_2 + x_2}} \qquad \sin w = \frac{x}{\sqrt{r^2 + x^2}}$$

k=ratio of transformer, is the factor by which the instrument reading (I_2) must be multiplied to give the primary current.

For ammeters $k = \frac{I_1}{I_2}$

For wattmeters the ratio is nearly $\frac{I_1}{I_2}$ but is influenced by the angle θ. The exact effect of the angle θ depends on the power factor of the load measured. If the power factor is $\cos\frac{\theta}{2}$ lagging current, it is evident that the wattmeter and ammeter ratios of the transformers will be the same. For the effect of the angle θ will be to cause the meter current to lead the line e. m. f. by $\frac{\theta}{2}$ thereby giving the same reading as though it lagged by the same amount. For lagging current power factors of less than $\cos\frac{\theta}{2}$ the wattmeter ratio will be less than the ammeter ratio, and for all other values it will be greater.

Given r, x, I_0, and I_2 to determine I_1 and θ.

The power components and wattless components of I_1 can easily be obtained from Fig. 3, as follows:

	POWER COMPONENT	WATTLESS COMPONENT
$-I_2$	$I_1 \cos w$	$I_2 \sin w$
I_M		I_M
I_W	I_w	
$I_1 = I_0 + I_2$	$I_2 \cos w + I_w$	$I_2 \sin w + I_M$

$$I_1 = \sqrt{(I_2 \cos w + I_W)^2 + (I_2 \sin + I_M)^2}$$

$$\cos\theta = \frac{I_2 + I_M \sin w + I_W \cos w}{I_1}$$

The curves in Fig. 4 were plotted from the above formulas for a standard three-ampere current transformer. Curve 1 shows the effect of resistance alone on the ratio. Curves 2 and 3 are for actual working conditions of the transformer when used on the coils of measuring instruments. Curve 4 shows the effect of a large inductance on the ratio. Such a high reactance is found only in the coils of relays for circuit opening devices, etc.

Current transformers and potential transformers are made in various sizes depending on the number of instruments they are to supply. All of the electrical conditions of a circuit can be told from the voltage and current and their phase relation. On the circuit there may be a voltmeter, an ammeter, an indicating wattmeter, an integrating wattmeter, and perhaps a power factor indicator, a frequency meter, and a connection to a synchronizer. One potential transformer may supply all of the potential coils, and one current transformer all of the current coils of these instruments, provided the transformers are of sufficient capacity. Transformers for

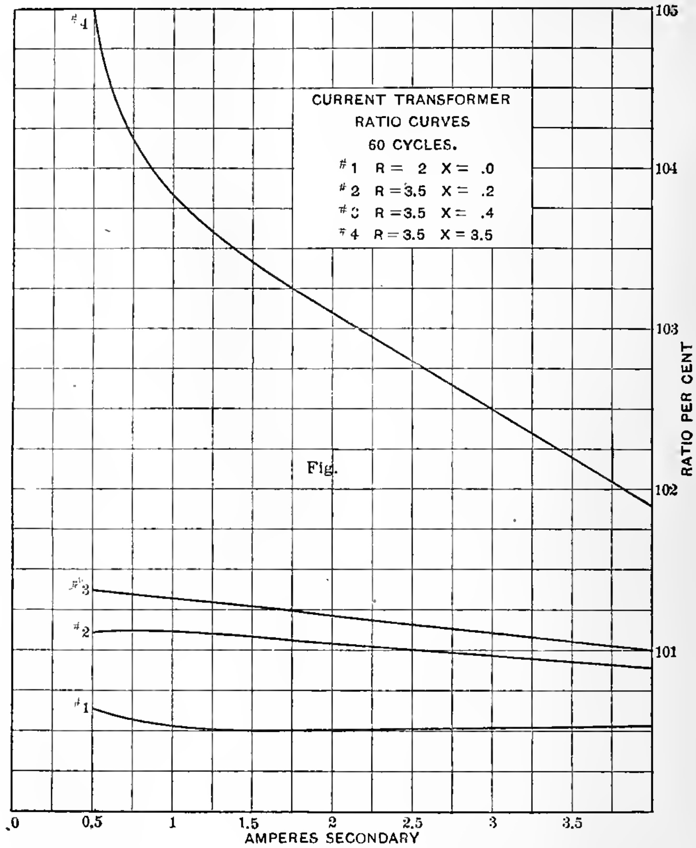


FIG. 4.

supplying the coils of relays are similar to the above in all respects. Owing to the high inductance of relay coils it is desirable that measuring instruments should in all cases be used on separate transformers.

THE LEAD OF A LEAD PENCIL AND A COPPER ROOF CATCH WIRELESS MESSAGES.

According to the "Cleveland Enquirer," Father Odenbach, head of St. Ignatius College, Cleveland, has discovered a method whereby he can intercept wireless telegraph messages by means of the copper roof on the college, some steel pins and the lead of an ordinary pencil.

While listening to the sounder connected with the ceronograph on the top of the college, by which lightning is recorded, Father Odenbach, who had substituted the lead pencil and pins for the usual expensive coherer in the instrument, heard the sounder tick off some Morse code characters. Investigation showed that he had intercepted messages received at the Clarke Wireless Telegraph Company's station, Cleveland, which came from the Detroit office.

At first the scientist did not understand the message, but he studied the code and finally was able to detect a few letters. Later he called in a telegraph operator, and the latter was able to take the message. It was found that the copper roof of the college, on which are stationed several weather recording machines, was a much better receiver than the poles and wires used at the regular wireless station.

The lightning recording instrument is so arranged that the sounder in the laboratory connected with the machine on the roof ticks when lightning flashes. It was through this machine that wireless messages were obtained. The regular stations use coherers that are very expensive and need constant attention, and Father Odenbach's discovery of the lead pencil-pin method is deemed important.

GROUNDED NEUTRALS OF STAR-CONNECTED ALTERNATORS.

This is a subject which has been causing a great deal of trouble to electrical engineers, both in this country and abroad. It has been found that if two star-connected alternators, with their neutrals earthed, are running in parallel, a large earth current may frequently flow between the two neutral points of the machines. The cause of this has sometimes been ascribed to dis-symmetry of the phases, and by changing over the windings of the stator this current has in some cases been reduced. Mr. E. P. Hollis, in a paper entitled "Points in Power Station Design and Operation," read before the Newcastle Local Section, touched upon the question, and expressed the opinion that a good deal of the trouble was due to the third harmonics of the wave forms of the machines. It is well known that at the neutral point of the star connection the third harmonics of the wave form (if they are present) give an alternating potential at three times the normal frequency of the alternator. These harmonics may give rise to capacity currents in the sheaths of the lead-covered cable, and the earth currents have often been attributed to this cause. Mr. Hollis thought that these were earth currents flowing between the generators, due to one generator having a third harmonic of greater value than the other, and thus a few volts gave rise to large currents flowing across the low earth resistance. His contention is supported by the fact that if only one generator neutral point is earthed, these earth currents are greatly, though, of course, not completely, reduced. It has often been noticed that if there are two similar circuits in parallel and conveying large currents, and one of these circuits be broken, a very little flash is obtained, because there is an alternative circuit for the current. By breaking the second circuit a large and brilliant spark is obtained. Now to apply this: Supposing there are two machines running in parallel with their star points earthed, if the currents noted were capacity currents, then on breaking one earth circuit one would not get a flash, as there would be an alternative circuit for the current—that is, up the other generator neutral point earth connection. But if the current is flowing between the two machines, then there will be no alternative circuit, and on opening the first switch one should get a flash; and all those who have open earth connection switches know that a brilliant flash is generally obtained, though, when at least three machines are running with their star points earthed, it may be obtained sometimes with one of two similar machines and not with the other. These earth currents are found to be of triple frequency when an oscillograph is put in the earth circuit. The conclusion arrived at by Mr. Hollis is that earth currents are flowing between the machines, and not between the machines, and the cable sheaths, and he asked: "Would it not, therefore, be advisable to insert in the earth circuit (when more than one machine neutral point is earthed), instead of the usual low resistance, an equivalent reactance? This would have the same effect as the resistance on all short-circuit and other currents of the ordinary frequency, but would have a triple impedance for the third harmonics' currents, and would tend to damp them down."

A SIMPLE LIGHTNING PROTECTOR.

In the protection of telephone cables an idea that may be valuable needs investigation. It was found from eleven years' experience in the installation of aerial cables that if a single loop two feet in diameter was made in the end of the cable, or even a "goose neck" of three or four feet in length, that in case lightning should puncture the cable, one need never look for trouble beyond this loop; that lightning coming into the cable from an overhead line would encounter such impedance at this point that it would jump the conductors and go to the cable sheath every time.

STEAM TURBINES AT COLLIERIES.

Sydney F. Walker.

The steam turbine is steadily making its way for colliery power plants. I believe that its first introduction in colliery work was at Ackton Hall colliery, in Yorkshire, in 1895. It belonged since, about 1890, to the late Lord Masham, who acquired it after it had been practically derelict for some time, previous owners not having been able to make it pay. The engineer who laid out the mechanical and electrical portion of the colliery, was a skilled electrician, and he had practically carte blanche from his owner. Lord Masham himself had naturally a very high appreciation of new inventions. He had realized a very large fortune by successive inventions in dealing with silk, and consequently his engineer had instructions to employ any apparatus, at any reasonable cost, that promised efficient working and economy. The engineer in question, who is now the manager of the concern, having succeeded his father in that post, told me that when he put down the first turbo generator, he did so mainly because the cost of the turbine and its dynamo was less than the cost of a reciprocating engine only, for the same work. The first turbine was succeeded by a second, and later by a three phase turbo generator, and I gather that the omnium gatherum of other electrical generating plants in use at the colliery, has been swept away in favor of turbines for the whole requirement. It used to be a very interesting sight at the colliery to see the different apparatus that had been laid down, as electrical engineering had developed. Space is not often of importance on the surface at a colliery, but the cost of buildings is, and the space occupied by a number of turbo generating plants, is so much less than that occupied by a number of reciprocating engine driven plants, that the cost of the building to house them is considerably reduced. The old question comes in again, of course, of the space required for the condensing plant, but very few collieries use condensing apparatus. Collieries seem to be divided roughly into two groups, those in which there is very little water indeed in the mine, and those in which there is a great deal. In both, however, it is not easy to obtain water for condensing, in a great many instances. It either has to be pumped from a distance, or a cooling tower has to be established. Water softening plants are becoming a necessity, even for boilers, while one of the very greatest necessities of colliery working is simplicity. The fewer apparatus there is about a colliery, and the simpler the arrangements, the better.

I notice, also, that Denaby Main, another of the leading collieries of Yorkshire, has also adopted turbines. Denaby has employed electricity very largely, almost from the time when it became practical, and it has spent a very large sum in doing so, with resulting economy in working. It was at Denaby that the test was made of the quantity of steam condensed in the steam pipes supplying an endless rope haulage plant underground. The pipe was stopped at the in-bye end, a steam gauge fitted there, and the pressure maintained at a figure that was required to work the haulage engine. It took, if I remember correctly, two large Lancashire boilers, to keep the steam at the pressure named, merely making good the losses by condensation. After a three phase plant had been put down, and the haulage plant was worked by three phase motors from it, the same two boilers furnished sufficient steam to drive the plant, setting free the other boilers that had been required to keep the steam going, apart from condensation.

Incidentally, it may be remarked, that the scarcity of water in most mining districts, suitable for boiler feed and for condensing, tends very strongly in favor of the gas producing plant, since the quantity of boiler water required is so very much smaller, and the water employed in the scrubber may be almost anything you like.

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Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," with which is incorporated "The Engineers', Architects' and Builders' News."
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VOL. XVIII MARCH 16, 1907 No. 11

EDITORIAL.

Distribution from the Sub-Station

Along with the many advantages possessed by alternating current for general electric light and power service, it must be admitted that its almost universal adoption for the generation and transmission of electrical energy has introduced many intricate details in the distribution of electric power from the sub-station. The delivery of energy to the service leads of the many customers, with their widely-varying requirements, necessarily requires a complicated equipment and system, not only of apparatus, but of mains, feeders and transformers. From the same station, as is set forth in the description of the Oakland Gas. Light and Heat Company's plants, which is to be found elsewhere in this issue of the "Journal," there is required direct current at 500 to 600 volts for street railway service, and also direct current at the same voltage, or 440 and 220 volts, three wires for elevator and similar motors. Alternating current, both single-phase and polyphase, at voltages from 2,000 to 10,000, and also constant current alternating service for the series enclosed arc lights for municipal and commercial purposes, covers, in most cases, the necessary alternating-current supply.

When compared with the old constant-potential, direct-current stations, the cost of the plant per kilowatt capacity is greatly increased when electrical energy in so many forms is required for light and power. Considering the generation of power, alternating-current machines usually have a higher efficiency than direct-current machines. However, with the numerous transformations and necessary sub-stations, even with large units and the very best apparatus, it is probable that the total efficiency of the modern electric light and power systems is not greater than the old direct-current stations. The large area which is supplied from one point, however, and the availability and flexibility of the service from the modern station makes it more satisfactory than its direct-current predecessor.

Between the customer and the generating station there is interposed in the modern plants many devices which may cause interruption of service, but the size of electric light and power stations at the present time has increased to such an extent that duplicate apparatus is almost invariably available. Therefore, while the number of links in the chain between the generating station and its customers has been greatly increased in modern plants, a corresponding increase has been made in the equipment. From the customer's standpoint, therefore, the service should be as reliable as that of the old direct-current plant. As a matter of fact, however, the regulation of voltage or pressure in many modern plants is not as good as was the case in the old, and now practically discarded, direct-current stations. For electric railway service and variable-speed motors, direct current will probably always be used to a very great extent, notwithstanding the very great improvement in alternating-current motors for both classes of service. For improving the load factor, however, as yet nothing has been suggested or perfected to take the place of the direct-current storage battery, and where the demand for power is subject to wide variation, either during very short intervals or over twenty-four-hour periods, the storage battery will probably retain, and even increase, its present position in improving the all-day efficiency of both the generating and sub-station plants.

For almost all electro-chemical purposes, direct current is a necessity, and while alternating-current motors for widely-varying loads and speeds, and also for electric traction, may be made to replace the present direct-current machines, in all probability, due to the advantage of the storage battery in improving the load factor, direct current will continue to be a large part of the required service from electric light and power systems.

ALCOHOL MANUFACTURE IN GERMANY.

Germany leads, to-day in the manufacture and use of alcohol for light and power. In that country potatoes are the chief source from which alcohol is produced. The potato crop last year reached the astounding proportions of 1,775,579,000 bushels, or more than 53,000,000 standard tons. Of this amount nearly one-half was used in the manufacture of alcohol and starch. One-eighth of all the tillable land in Germany is planted to potatoes, which show an average production of 217 bushels an acre, which sold at an average of 27.6 cents a bushel, or about $60 an acre. In France alcohol for manufacturing purposes is made chiefly from molasses and sugar beets.

BOOK REVIEW.

Concrete Factories.—An illustrated review of the principles of construction of reinforced concrete buildings, including reports of the Sub-Committee on Tests, the U. S. Geological Survey, and the French Rules on Reinforced Concrete. Compiled by Robert W. Lesley, Associate Am. Soc. C. E. Published for the Cement Age Company, by Bruce & Banning, New York.

Reinforced concrete in building construction has already proven its adaptability, and constructing engineers all over the world are using it extensively in every branch of engineering work.

For this reason the importance of determining by a series of exhaustive tests, scientific formulae for its use has resulted in the creation of a Joint Committee on Concrete and Reinforced Concrete, the members of which are representatives of all the leading engineering societies.

The scope of the work to be done, explanation of the field to be covered, and an outline of tests to be made is shown in Reports of the Sub-Committee on Tests made to the Joint Committee. This is published in full, together with a complete report governing the use of reinforced concrete in France.

These reports, with an article by Mr. Grumby on Surface Finish for Concrete, and some views of leading engineers and architects on this subject as a conclusion, complete the matter in the books. It will be of value to every engineer.

"The Use of Alcohol and Gasoline in Farm Engines," published by the U. S. Department of Agriculture, being Farmers' Bulletin No. 277. By Chas. Edward Luche, M.S., Ph.D., assistant professor of mechanical engineering, Columbia University, and S. M. Woodward, M.S., M.A., irrigation engineer, office of experiment stations.

TRADE CATALOGUES.

G. E. Witt Co.—Catalogue No. 6, devoted to Little Giant Crude Oil Burners, Pump Governors, Reducing Valves, etc. 1165 Howard Street, San Francisco.

"Brills Magazine," published in the interests of the J. G. Brill Co., Philadelphia; American Car Co., St. Louis; G. C. Kuhlman Co., Cleveland, and The John Stephenson Co., Elizabeth, presents special features of semi-convertible cars for Boston, in a very attractive manner.

The Wellman-Seaver-Morgan Company.—A neat, well-illustrated circular on the Hughes continuous gas producers, has just been issued by this company. Description of producer is given, with cuts and diagrams showing clearly its construction. A number of illustrations of plants already equipped with this appliance are also shown. Applications for this catalogue should be sent to the above company, at Cleveland, Ohio.

The Mutual Gas and Engineering Co. have sent out a folder descriptive of "The Foveaux Fluid Controller." This device is a combination valve and pipe fitting, and will interest all engineers, boards of public works, fire insurance companies, and others interested in the safe and economical distribution of gas, water and other fluids through public streets. Address all requests for copies to the above company, at 801 Union Savings Bank Building, Oakland, California.

Westinghouse Electric & Manufacturing Co.—This company have just issued the following circulars:

No. 1131.—Westinghouse Graphic Recording Meters, illustrated, showing the various types and their construction.

Folder No. 4074.—Oil Circuit Breakers, Types B, F and J, for Potentials from 3,300 to 22,000 volts.

Folder No. 4070.—Type E Oil Circuit Breakers, Hand Operated, Distant Control.

Folder No. 4073.—Type G and L, Oil Circuit Breakers, 60,000 volts, 100 amperes.

Westinghouse Oil Switches, Types D and J.

The Holtzer-Cabot Electric Co.—Bulletin No. 303A, replacing No. 303 on special elevator motors, with cuts and data regarding same.

Form No. 1028.—Lineman's "Receiver Type" Testing Set.

Form No. 1025—Universal Lineman's Testing Set.

Form No. 1024.—A Water-Tight Telephone.

Circular No. 205A.—The Flexiphone; a combination desk telephone instrument and adjustable arm.

Bulletin No. 310A, displacing No. 310.—Magneto Power Generators.

PERSONAL.

Mr. E. L. McKie is now at the head of the sales department of machine tools for Herron, Ricard & McCone, 436 Market Street.

OAKLAND HARBOR IMPROVEMENT.

The San Francisco, Oakland & San Jose Railroad Company (Key Route) has started the work of constructing the new harbor basin on the water front, south of its present pier, and the work is to be pushed rapidly. A large dredger at the foot of B Street will go to work at once dredging out the space lying between the tracks of the Key Route and the Southern Pacific mole. It is thought that in making a channel to the wharves which will be built along the sides of this basin to a depth of thirty feet, sufficient material will be secured to fill in the 500 acres of land owned by the company along the north side of the basin. The amount of material to be dredged to give the channel a uniform depth of thirty feet will be 5,000,000 cubic yards, and this amount will cover the filled land to a depth requisite for its usage. This filled land will be utilized for sites for railroad terminals and for manufactories. A track will be extended from the wharves which abut on this filled ground to the proposed branch of the company on Wood Street, which will give the company an outlet in that direction, and will give it further connections with such railroad lines which may be seeking the water front for terminal facilities. The work of dredging out the channel and the construction of the new wharves, which will give accommodations for fully 200 vessels of the largest size, will be under the supervision of Howard Holmes, the well-known engineer.

AN INTERESTING EXPERIMENT.

Professors Joseph Le Conte and Noble, of the Department of Electrical Engineering of the University of California, having found it impossible to obtain any satisfactory data on the windage loss of a revolving element, are conducting some interesting experiments in this connection at the University.

The apparatus consists of an iron pulley wheel of large diameter to which wooden blocks of the same shape and size of the field coils of a revolving field-type generator are attached. This is surrounded by a stationary wooden ring built up in the form of the stationary windings of the armature. With this arrangement it is hoped to determine a definite relation between the windage, or air losses of a generator and the speed of rotation.

INDUSTRIAL

A NEW HIGH PRESSURE BLOWER.

A Rotary Blower with Two Stationary and Two Rotating Parts.

To its large variety of centrifugal or fan blowers, the B. F. Sturtevant Co. has added a blower of the positive or rotary type, Fig. 1. Built for pressures up to 10 pounds a square inch it is suited for cupola work, smelting, hardening and annealing furnaces, pneumatic tube systems, etc. The same design is successfully used for handling air or gas on an exhauster, the stuffing boxes preventing leakage at the points where the shafts pass through the end plates.

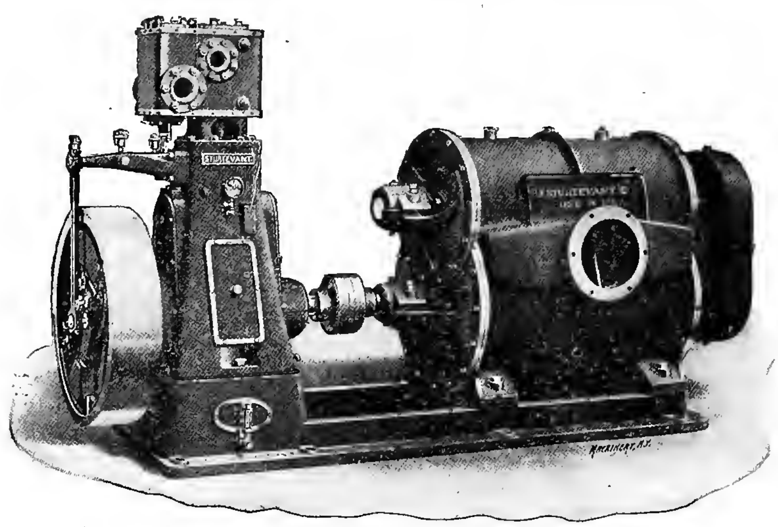


FIG. 1. NO. 4. BLOWER DIRECT CONNECTED TO VERTICAL ENGINE.

Features that make this blower different from others of the positive type are the ample clearances, which render unnecessary elaborate adjustments of journal boxes, and the absence of work done by one of the rotors, thereby reducing the power transmitted by the gears to an amount necessary to overcome the friction of the journals. The practically constant power thus transmitted admits of the use of the same gears for all pressures.

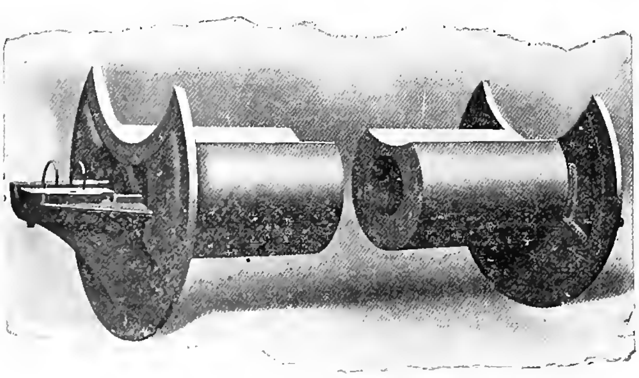


FIG. 3. THE IMPELLER.

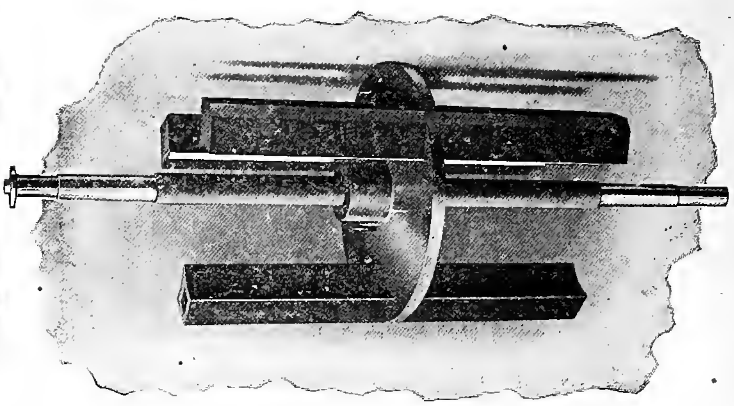


FIG. 2. STATIONARY CORE WHICH IS PLACED OVER IMPELLER SHAFT.

Construction of Blower.

The blower consists of but four principal parts—two stationary and two rotary. The symmetrical casing or shell is of cast iron provided with end plates or covers which support the chain-oiling bearings and make an air-tight housing. On either side of the casing are intake and discharge openings, flanged, drilled, and tapped for standard gas-pipe fittings. The other stationary part seen in Fig. 2, a cylindrical core projecting inward from the end plates that support the impeller shaft, forms with the casing an annular space in which the impeller blades turn.

One of the rotors, the impeller shown in Fig. 3, does the entire work of compressing and moving the air or gas. Consisting of three diamond-shaped bars or blades, it successively forms within the annular space three pockets in which the air is imprisoned and carried around to the discharge. The volume of each pocket is decreased as it nears the discharge, and consequently it delivers air at greater density.

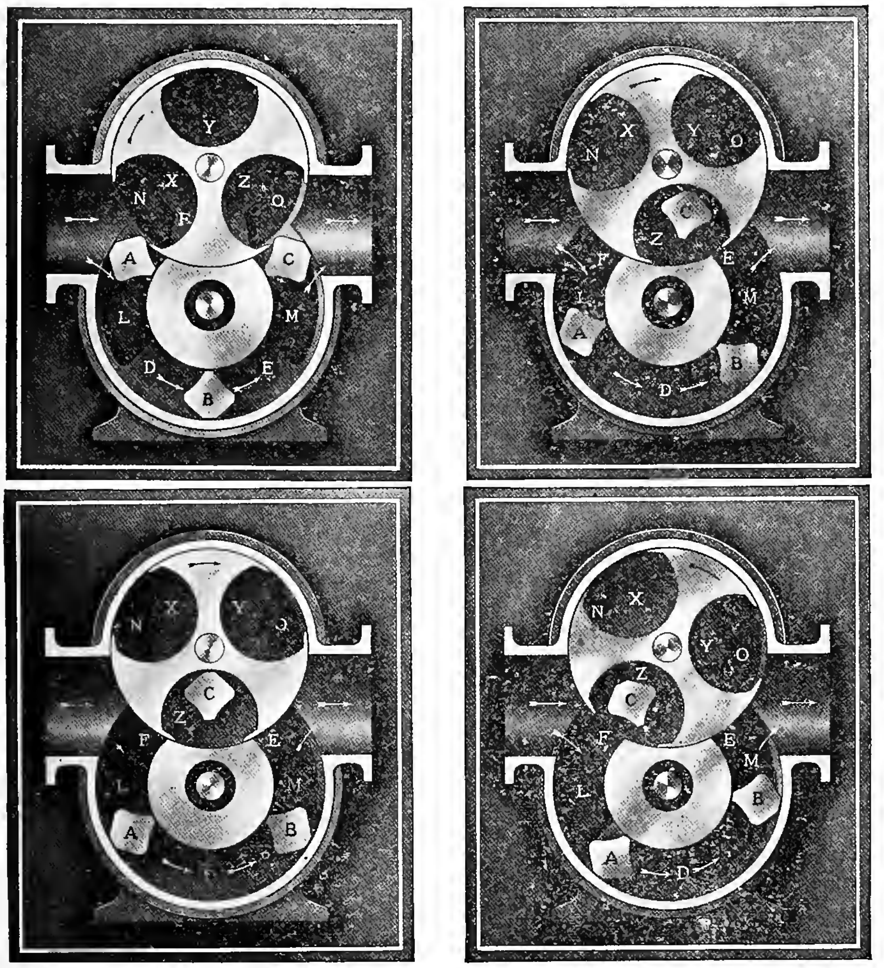
The second rotor, Fig. 4, called the idler because it does no work, revolves at the same speed as the impeller to which it is connected by spur gears, the shafts upon which the rotors are mounted being parallel. The function of the idler is to allow the impeller to return to the suction side without loss of compressed air. This is accomplished by having the blades of the idler of such shape and size that they always cover the opening.

Ample clearance between the rotors is provided for in the design, one-eighth inch in small sizes and one-half to three-fourths inch in large sizes representing the distance. This is sufficient to insure safe operation even with considerable var-

iation in the running of the gears. The clearance between the rotors and the casing, while not as great as between rotors, is sufficient to prevent contact. The effect of clearance is intentionally increased by passages formed in the end plates, the function of which is taken up in connection with the explanation of operation.

Operation.

Air or gas at atmospheric or suction pressure entering the blower at the intake is successively imprisoned in the three pockets formed by thè three blades of the revolving impeller, and, since these volumes are reduced as the impeller blades pass into the idler spaces, the air is discharged at any desired pressure up to ten pounds a square inch. The volume of free air displaced each revolution is constant, the pressure varying with the speed and with the resistance to the passage of air.



FIGS. 5, 6, 7, 8. SECTIONAL VIEWS OF FAN NUMBERED FROM LEFT TO RIGHT AND SHOWING ROTATING PARTS AND STATIONARY CORE IN DIFFERENT RELATIVE POSITIONS.

The principle upon which the blower operates is clearly shown in Figs. 5, 6, 7 and 8, which are sectional views illustrating four successive stages in the movement of the rotors. In the explanation it is assumed that the blower is running at a speed to produce average pressure, and that this pressure exists in the discharge outlet.

While the rotating members are advancing to the positions shown in Fig. 5, air enters and completely fills space X and chamber D, while pockets E and Z are discharging air against the pressure in the delivery pipe. From the previous movement of the rotors, the pressure in Y, filled with air carried over by the revolving idler, has been increased slightly by air flowing through the leakage passage N. The space between blades A and C, just above the concave portion of the core, is practically filled by the wing of the idler, and consequently it takes no part in the action. Space Z is about ready to receive impeller blade C and pass it to the suction side.

While revolving from the position shown in Fig. 5 to that shown in Fig. 6, the air in pocket D has been carried along, and free communication between chamber D and the inlet has been cut off. If, however, the speed was such as to prevent D becoming filled to atmospheric pressure, the leakage passage L allows the flow to continue; but this effect is very slight. Space Z is filled with air under pressure, which further movement will carry toward the suction side where it would flow back to the inlet and in escaping, cause noise. But this loss and noise is lessened by the leakage chamber O, which allows the pressure to be transmitted to the air in space Y, thereby still further increasing its density. Leakage back to the suction side is prevented by the wing of the idler.

Continued rotation carries the rotors to the positions shown in Fig 7; atmospheric air is now entering pocket F, the air in D is being carried around between blades A and B in the annular space, and E is discharging. Impeller blade C is moving toward the suction side in the space Z. Above the impeller the remaining pressure in Z is being transmitted to the air in X by means of the leakage passage N provided for the purpose, thereby making its pressure a little greater than atmospheric. The air in space Y under slight pressure from previous leakage is imprisoned, and being carried around by the idler.

When the fourth position is reached, pocket F will be filling, the pressure in chamber Z will have been reduced nearly to atmospheric by leakage, space Y will discharge, and a little compressed air from the delivery pipe will flow back through leakage passage M and increase the pressure in D, which will result in a quieter discharge taking place when further movement brings B into the discharge passage.

The purpose and advantage of the leakage chambers is now apparent; they make it possible to recover the pressure which otherwise would escape from the impeller pockets and by making the increase in pressure gradual cause the blower to run with less noise. Leakage passage L has practically no effect when the blower runs at ordinary speed and in the direction shown here; it is provided to make the blower symmetrical, thus allowing it to run in either direction.

It will be noticed that the impeller carries three blades, set at equal distances around the periphery, thus causing three admissions of air at each revolution.

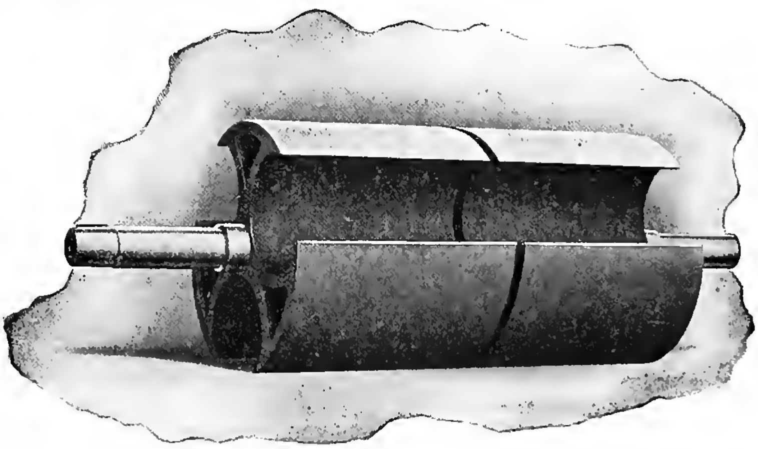
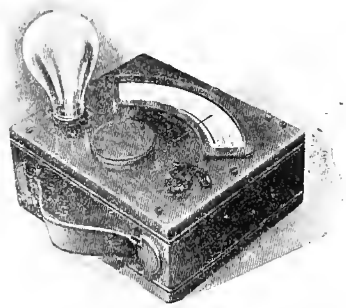


FIG. 4. THE SECOND ROTATING PART, CALLED THE IDLER.

COMBINATION PORTABLE WATTMETER.

The Wagner Electric Manufacturing Co. is introducing a portable instrument which has such a multiplicity of uses that we believe central station managers and manufacturers will find it of great value, both in the introduction of their goods to the general public and in testing lamps and accessories used by their new business departments in the campaign for business.



The instrument carries a lamp socket imbedded in the case, which socket extends, perhaps, one-eighth inch outside of the case, in which socket is placed the lamp or the attachment plug connected with the device under test.

Over to the right-hand side, as shown in the cut, is a little hard-rubber switch; this switch carries two pointers, one on each side. One of the pointers is marked 110 (or 150 volts, as the case may be), and the other pointer is marked 220 (or 300 volts, as the case may be). The instrument is designed in such a way as to be suitable for operation on both 150 and 300-volt circuits, by simply throwing the switch to the proper voltage point.

Each side of this switch, that is, the 150-volt side and 300-volt side, travels over an arc which has three stopping points: The first reading "volts," the second, "watts," and the third, "off."

While central station managers will find this instrument of great value in influencing their purchase of lamps and other current-consuming devices, the sale of which is being so generally pushed by the new business departments, they will also find it is of great value in their engineering department in the determination of core losses in small lighting and power transformers; this combination lamp-testing volt wattmeter is well adapted to this purpose.

Scales: This instrument has a double scale, a voltage scale reading, say, up to 150, and wattage scale reading up to 150 watts, there being one needle covering both scales. This needle is actuated by the voltage movement when the switch is on the point marked "volts," and is actuated by the wattage movement when the switch is on the point marked "watts." The instrument thus serves the double purpose of being a voltmeter and wattmeter combined.

When the switch is on the 300-volt side, the scale readings are to be multiplied by two, thus giving a range in both the voltmeter and the wattmeter movement, form 0 to 300.

The instrument, as ordinarily furnished, is put out in a neat, hard-maple carrying case, although, in addition to this, a leather carrying case with shoulder strap, is supplied at a small additional cost.

The multiplicity of uses to which this instrument can be put will appeal to engineers, as, in addition to the testing of lamps, it will be found very useful for the testing of small motors, water heaters, coffee percolators, etc.

In the purchase or sale of lamps, for instance, this instrument will prove very valuable. A lamp manufacturer or a manufacturer making small current-consuming devices and making good goods, can receive only benefit from it, as the use of this instrument by his salesman, in addition to showing up the good points of his own apparatus, serves to accentuate the deficiency of inferior types.

Cut No. 2186 shows the method of connecting the instrument and the transformer under test to the testing circuit. Great care should be taken that the primary or high voltage leads of the transformer are on open circuit and disconnected from all other circuits.

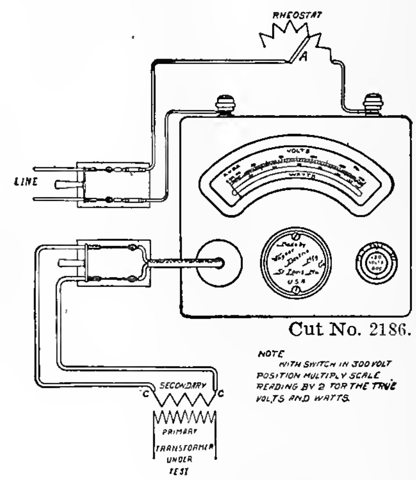
A rheostat or resistance is shown at "A," and is necessary for adjusting the voltage of the transformer terminals. This resistance should be of about 180 ohms, and of approximately two-ampere capacity. An ordinary field rheostat of about two-ampere capacity will be found convenient.

It is preferable, however, to adjust the voltage of the generator where this can be done, and it is usually possible to do this at time of light load. Owing to the low power factor of this test, care should be taken not to leave the current on the coil longer than necessary to take a reading.

The following iron loss measurements may be expected in transformers of recent manufacture, losses taken either on 110 or 220-volt, 60-cycle:

Trans. K. W. Cap.	Approx. Watts.
1 to 5	30 to 100
7½ to 15	100 to 200
15 to 30	200 to 300

Core loss tests which are to be used for comparative purposes, such as ageing tests, should be made under as nearly the same conditions as possible. The speed of the generator (or the frequency of the circuit) should always be the same, since the frequency will affect core loss readings. If possible, tests should be made when the load on the generator is light, as the nature and amount of the load may effect the readings considerably. These precautions apply only to core loss tests, and need not be observed in testing lamps.



Cut No. 2186.

The actual operation of the test is as follows:

Connect up the transformer and instrument in accordance with diagram, setting rheostat so voltage on the instrument when switch is placed on point marked volts, is the same as the rated secondary capacity of the instrument. That is, 110 or 220 volts. With switch on point marked watts, the instrument reading will be the actual iron loss of the transformer.

Quotations will be furnished to all interested parties writing to the factory or to district representative.

Los Angeles, Cal.—The California-Nevada Electric Power Co., with a capital stock of $10,000,000, of which $5,000 common has been subscribed, has filed articles of incorporation. The new company will manufacture and transmit electricity for the use of railroads, quarries, municipalities, and consumers in general. It also reserves the right to dispose of water and water rights and to do all things for which a corporation is formed. The stock has been divided into 5,000,000 preferred and 5,000,000 common. The directors are Rea E. Maynard, of Los Angeles, F. G. Baum, of Berkeley, F. V. Keesling, C. R. Lewis and O. K. Grau.

NEWS NOTES

ELECTRIC RAILWAYS.

Boise, Ida.—The Boise and Interurban Electric Ry. Co. announces that its line between this city and Caldwell will be in operation by May 1.

Loomis, Wash.—Don A. Dewey is here securing the right-of-way for the Okanogan Electric Ry. Co. in this valley.

Portland, Ore.—Work has been commenced grading for the Oregon Electric Co. in South Portland. Chief Engineer Donald has charge of the work.

Palouse, Wash.—The work of laying steel on the main line of the Spokane & Inland has been completed.

Tacoma, Wash.—Engineers in the employ of the Tacoma Ry. & Power Co. are making final surveys of the route between this city and Orting.

Tacoma, Wash.—The Tacoma Ry. & Power Co. has commenced laying a second track between Hosmer Junction and Pine Street. The company will also erect a new depot.

Victoria, B. C.—Work will be commenced next week on the construction of new car sheds for the B. C. Electric Ry. Co. on Discovery Street. A. T. Goward, manager.

Walla Walla, Wash.—Contractor Nicholas Wierk will begin work at once on the new car barn of the W. W. Valley Traction Co. at 13th and Cherry streets. The building will be a one-story brick 60x150 feet, with 20-foot ceiling.

Astoria, Ore.—Council granted a thirty-year franchise to S. D. Adair and E. B. McFarland for a street railway leading from Commercial Street to the county bridge at Young's Bay, where it is to connect with a railway running to Warrenton and New Astoria.

Burley, Ida.—W. D. Kenyon, who has geen granted a franchise with others to build an electric railway in Cassia County, advises that the company which will be organized will be known as the Idaho & Nevada R. R. Co. The line will extend from this place to Oakley, a distance of twenty-five miles.

Everett, Wash.—The Everett Railway & Electric Co. announces that it will extend its electric line to Silver Lake, a distance of five miles.

Portland, Ore.—The county commissioners granted a franchise for an electric railway line on the Sandy Road to extend from the intersection of the Sandy Road with East Sixteenth and East Davis streets in a northeasterly direction towards the Columbia River. It will be built and operated by the Portland Ry., Light & Power Co.

Rosalia, Wash.—The foundation is being laid for the sub-station of the Spokane & Inland at Rosalia. The building will be of brick and 60x60 feet. The Spokane & Inland will furnish power and light for Rosalia.

Spokane, Wash.—The Washington Water Power Co. increased its capital stock to $1,000,000. The increased capital will be used for extensions and betterments to the system.

Tacoma, Wash.—The Tacoma Ry. & Power Co. will build a loop at the end of the American Lake line.

Tekoa, Wash.—The Tekoa and St. Maries River Ry. Co., capital $500,000, has been incorporated by T. J. Mahoney, W. A. Mosier, T. H. Follett, E. C. Dowel and William Hoare. Principal object to construct a line of railway from Tekoa to a point on the St. Maries River in Idaho, a distance of fifty miles. Electricity will be the motive power.

FINANCIAL.

San Francisco, Cal.—One of the most important actions affecting financial interests yet taken by the Supervisors was that taken February 28th, when the Board declared forfeited to the City and County of San Francisco all the franchises of the Spring Valley Water Co. and the waterworks themselves. The action was taken by the Board because of the alleged violation of the law and the Constitution of California in charging a different water rate from that established by municipal authority. The formal resolution of the Board recites that the Constitution of the State of California expressly provides that any company collecting water rates otherwise than as established under the authority granted by the Constitution shall forfeit the franchises and waterworks of such company to the city and county where the same are collected. It further recites that the Spring Valley Water Co., through its duly accredited officials, in the recent water rate investigation, testified under oath that the company was still collecting rates in contravention of those established by the Board of Supervisors; and that, therefore, it is resolved that the Board of Supervisors declare "all franchises and waterworks of said Spring Valley Water Co. forfeited and escheated for the public use to the City and County of San Francisco."

Attorney Kellogg, of the company, says: "We are not going to lose any sleep over this action of the Supervisors. It's a joke. I don't know what move the Board will make, but we shall certainly fight the city in the courts to a finish in this matter. There is nothing for us to do just now. We shall await an attack. The company is not conscious of any wrong-doing, and we shall go ahead defending our rights. This resolution doesn't mean anything at all."

President Payson says: "This comes as a great and unexpected surprise to me, and I cannot express myself on the matter until I have consulted my attorneys. I can state that the Spring Valley will do all in its power to resist such action on the part of the Supervisors. This company will take the matter into court, and as far as the law will give remedy we shall take it. What we have done to break the law is not clear to us yet, but as soon as we are informed of the grounds on which the Supervisors based their action we shall be able to answer."

The basis of this disagreement seems to be that the company and the Supervisors disagree about the valuation of the plant. City Engineer Woodward has placed the value of the plant at $24,569,328, while the officials of the corporation desire to charge enough to get interest on $51,405,000, which they claim the property is worth. Included in the company's estimate is their idea of the value of prospects in Calaveras and Tuolumne counties, although the Spring Valley does not own any property or rights in Tuolumne County and has not developed its holdings in Calaveras County. Furthermore, President Payson claims that the company lost $800,000 by last April's disaster and has been since losing $20,000 a month.

Oakland, Cal.—The People's Water Co., through its attorney, M. C. Chapman, gave notice at the last meeting of the committee of the whole of the City Council that it would demand that the value of its Oakland plant for water purposes be assessed at $10,000,000. This is an increase of $3,000,000 over Judge Hart's valuation, and practically an increase of $5,000,000 over the valuation placed upon the plant last year by the City Council.

ILLUMINATION.

Compton, Cal.—The Compton Lighting & Power Company, recently incorporated with a capital stock of $50,000, will immediately begin preparations for the erection of a 6,000-light plant on Pomegranate Street, where the first unit will be installed. A franchise has already been purchased through G. R. Fulton.

Pasadena, Cal.—Bids for the latest addition to the building of the municipal electric light plant have been received and referred to the head of the department for his report. The plans call for the expenditure of about $50,000, and involve the tearing down of a portion of the old building.

Anaheim, Cal.—Remodeled plans for the new power house have been submitted by City Engineer Schenck. Bids for the construction of the building are to be opened March 14th. On the recommendation of Mr. Schenck all bids for new arc lights were held over pending an investigation of the results of the new flaming arc light now being tried in Los Angeles.

OIL.

Los Angeles, Cal.—Oil circles have a sensation in the alleged repudiation of the Associated Company of its immense contract to supply the Los Angeles Gas Co. It calls for 300,000 barrels annually, was made in 1904 and does not expire until 1910. The stipulated price is between forty cents and forty-five cents a barrel, delivered, not over half the rate now charged on contract. The gas corporation threatens suit for heavy damages unless a compromise is effected. The Associated bases its action on the ground that the gas company violated its contract by buying additional oil from other companies at a much higher price. The buying concern declares that this has no bearing on the Associated Company's contract. The latter's officers here absolutely refuse to discuss the affair, except to deny that their action is due, as other oil men believe, to the higher price and shortage of output. It is the opinion among oil men that the Associated has done right in refusing to deliver any more oil to the gas company, in view of the fact that the other has repeatedly broken its part of the contract. It is not likely that anything will come of the proposed suit.

Sisson, Cal.—Several of the large lumber companies of Northern California have concluded to use oil for fuel in their locomotives. It is known that a large proportion of the destruction wrought by fire in our forests has been occasioned by sparks from locomotives. While the companies have taken this action as a matter of self protection, the forestry department has a ruling that no company shall enter the reserves that uses fuel other than oil.

Los Angeles, Cal.—The Santa Monica Oil, Gas and Mining Company, a new company, owns 3,260 acres of land ten miles northeast of Santa Monica in the district said to be the best oil region of the State. Gold is also found on the land in some quantity. The work of developing the property will begin at once, and the promoters are enthusiastic over their holdings.

ENGINEERING.

Boise, Ida.—T. W. Thomas, secretary of the Big Lost River Land & Irrigation Co., stated that Engineer Darlington will be in charge of the construction work at Mackay. A canal thirty-six miles long will carry water from two large reservoirs, one four miles from Mackay and the other in Blaine.

Huntley, Mont.—Bids are asked by the U. S. Reclamation Service until April 7th for constructing structures on Garland Canal and laterals near Ralston, Shoshone project. The work involves about 47,000 cubic yards of grading, 5,000 cubic yards of concrete, placing 348,000 pounds of steel reinforcing bars and other incidental work.

Paterson, Wash.—The State Irrigation Co., capital $100,000, with C. W. Corliss, of Seattle, secretary, and Dr. C. W. Sharples, president, will install a pumping plant with a 250-horsepower boiler to furnish water for their desert land claims.

Salem, Ore.—The Josephine-Klamath Co. has been incorporated with a capital of $1,000,000, by F. William Russ, F. D. Smith and R. C. Maxwell. This company will engage in agricultural, mining and irrigation work in the counties of Josephine and Klamath.

Spokane, Wash.—Charles Swanson and associates, of this place, have purchased 300 acres of land on the Columbia in Lincoln and Douglass counties. They will install a model irrigation plant at a cost of $30,000.

TELEPHONE AND TELEGRAPH.

Emeryville, Cal.—The town trustees have awarded a telephone franchise to the Home Telephone Company, and at the next meeting will adopt a franchise formally granting the company the right to use the city streets.

Oakland, Cal.—It is announced that the Pacific Telephone & Telegraph Company will spend $1,125,000 in improving the service on this side of San Francisco Bay. Of this amount about $400,000 will be spent in Oakland.

Berkeley, Cal.—In the ordinance just passed providing for a bonded indebtedness for public improvements, there is an item calling for $11,000 for the purchase and installation of a fire alarm telegraph system.

WATERWORKS.

Santa Clara, Cal.—A special election will be held in this city on April 8th to vote on an issue of bonds to the amount of $80,000 for municipal improvements. Of the total amount, $21,000 is to be used for the reconstruction and repair of the water, light and power works.

Tucson, Ariz.—Large flows of water are being developed along the Santa Cruz River, south of this place, by means of pumping plants. A plant to cost $20,000 is now projected on the Canoa Ranch, where a flow of 7,000 gallons per minute is to be developed.

Santa Ana, Cal.—Officials of the Edison Electric Company are here figuring on the cost of replacing steam by electric power in the local waterworks.

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TRANSPORTATION.

Winters, Cal.—The Vallejo and Northern Electric Railway Co. has applied for a franchise along the Vallejo water front, and the Monticello Steamship Co. has asked for the same ground. The city trustees have postponed the consideration of the requests until a special meeting. The railroad has announced its intention to put in a line of steamers to compete with the other corporation for the San Francisco traffic. The survey of the railroad passes through Pleasant Valley and crosses Putah Creek in the richest fruit district of Yolo County, and the company promises to be a strong rival of the Southern Pacific in the fruit-carrying line.

Redlands, Cal.—It has been announced that a double track will be laid by the local traction company on Orange and Cajon streets.

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Risdon Iron Works
Tracy Engineering Co.

Pumps—Air Lift and Artesian
Henshaw, Bulkley & Co.

TRANSPORTATION.

Colusa, Cal.—Because of the deadlock over the desired water-front franchise it is rumored that the Northern Electric Co. will not come to Colusa, but will build into Williams. The surveyors are working two miles south of Colusa, surveying west.

Bisbee, Ariz.—Work has begun on the Warren-Bisbee electric street car line, which is to have a total length of five miles. The contract has been awarded, and the construction will be finished in 170 days.

Pasadena, Cal.—The survey of the La Canada, Pasadena and Los Angeles railroad has been completed to within a short distance of Devil's Gate, and laborers are being sent in to put up buildings and prepare for graders.

Los Angeles, Cal.—The city council has repealed the ordinance granting a subway franchise on North Hill Street, connecting Sunset Boulevard and First Street, to the Los Angeles-Pacific Electric Co. The Company was to pay $1,000 for the privilege, but made no tender of the money and declined to bid for the connecting subway between First and Temple streets.

San Francisco, Cal.—The Bay Counties Electric Road, which a few days ago secured a continuous right of way from Richardson's Bay to Lakeport, is busily engaged in making surveys and arranging for the work which is to start within the next sixty days. The road, which is to be operated by electricity, will have a terminus near Belvedere, and the trip from there to San Francisco will be made in about forty minutes. From Belvedere the road will be built to Greenbrae across the marsh, thence over the lands of the Ferris, Mackay and Flood estates. A large depot will be built in San Rafael. From there the road will continue through the Town Ranch into Novato, through Sonoma County to Lakeport, Lake County.

CLASSIFIED LIST OF ADVERTISERS—CONTINUED

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THE

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The Engineers' Architects' and Builders' News

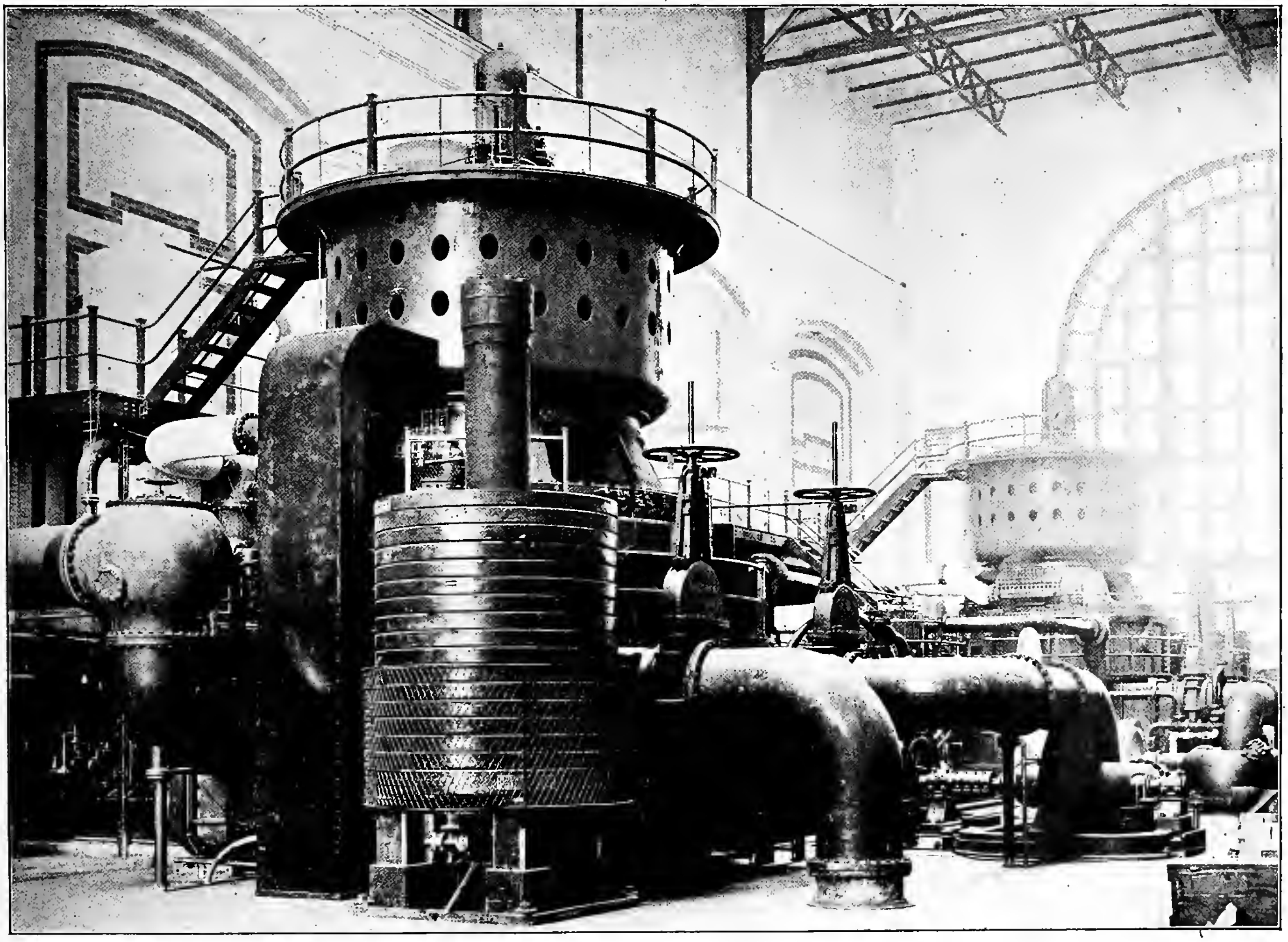
VOLUME XVIII. SAN FRANCISCO, CAL., MARCH 23, 1907 No. 12

The Boston Steam Turbine Electric Station.

One of the most thoroughly up-to-date and interesting central stations in the United States is that of the Edison Electric Illuminating Company, of Boston, Mass., equipped with four stage Curtis steam turbines, as shown in the accompanying illustrations.

The steam turbine station is located adjoining the old plant which is equipped with reciprocating engines of the alternators noted in the accompanying views of the turbine plant equipped by the General Electric Company, of Schenectady, N. Y.

Each of the 5,000 kilowatt units consists of a four-stage Curtis steam turbine operating at a speed of 514 revolutions per minute and directly coupled to a General Electric three-phase alternator supplying a current of 6,600 volts pressure



5,000-KILOWATT CURTIS TURBINES DIRECT CONNECTED TO 6,600-VOLT GENERATOR.

compound type, the latter having been installed by the Boston Electric Light Co. several years ago. The old plant includes a half-dozen units of 1,500-kilowatts each, vertical compound engines of the McIntosh & Seymour type, being directly coupled to electrical generators of a combined capacity of about 9,000 kilowatts, while the total output of this plant could easily be carried by the two Curtis turbo- and a frequency of 60 periods per second. The turbines are mounted upon especially designed surface condensers which form the base of the turbine structure as noted in the accompanying illustrations.

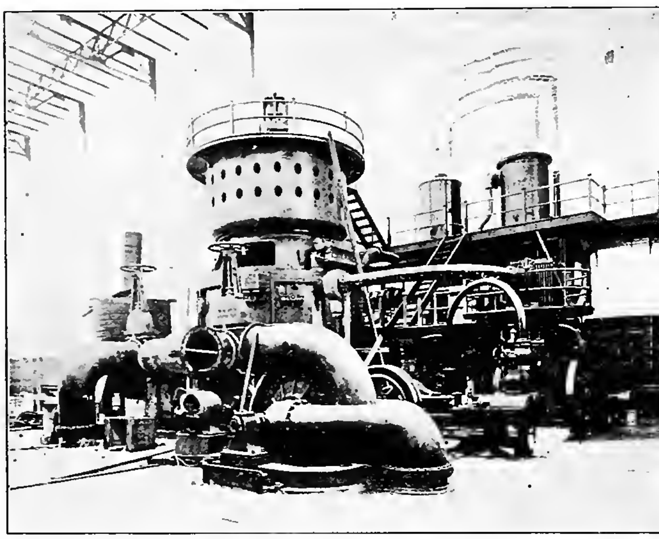
The revolving field of the alternator mounted on the top and forming the upper portion of this 5,000 kilowatt unit is nearly nine feet in diameter and weighs nearly 35 tons, the

total weight of the turbo-alternator without the condenser being 230,000 lbs. It is stated that the total weight of each unit is 260 tons, which is about 4,000 lbs. or two tons per square foot of base.

The turbine station of the Boston-Edison Illuminating Co. was designed for a dozen units of 5,000 kilowatts each, or a total output of 60,000 kilowatts, while the turbo-alternators installed have a maximum overload capacity of 50 per cent for two hours without danger, so that the total peak load capacity of the station is nearly 100,000 kilowatts when fully completed.

Each of the Curtis four-stage turbines has 15 sets of initial nozzles on each side, with three rotating discs, each carrying two sets of blades, the turbine wheels each having a diameter of about 13 feet. To each of the nozzle chests of the turbines is connected a 10-inch pipe connecting with a 15-inch steam main and no exhaust pipe is necessary, as the turbine is mounted directly upon the condenser, as mentioned above, and there is an automatic release valve arranged for discharging into a free exhaust main two and a half feet in diameter.

The turbine station is constructed on the unit plan, each pair of turbines being supplied with steam from its own bank of boilers arranged in four batteries of two boilers each of 513 horsepower capacity for each turbine unit, as well as the necessary condensing and other auxiliary machinery required. The boilers each have a heating surface of 5,118



ANOTHER VIEW OF 5,000-KILOWATT CURTIS TURBINE.

square feet with a grate area of 110 square feet, measured on the inclined plane of the Roney stokers and a superheating surface of 867 square feet. These boilers have tubes 18 feet long, 14 tubes high and 18 tubes wide, and the steam pressure carried is 175 pounds per square inch with steam superheated by 150 degrees.

The total length of the boiler house and turbine room is to be, when completed, 640 feet, the boiler house being 150 feet wide, and the turbine room nearly 70 feet in width. Each pair of turbines forming a group, with its boilers and auxiliary equipment is provided with a separate chimney, there being six chimneys designed for the completed station of 90,000 horsepower capacity.

The coal is brought by boat to the wharf at the power station, which is provided with two towers, equipped with buckets of one and one-half tons respectively, delivering the fuel to a belt conveyor which conveys it to a bridge 60 feet high, with a span of 155 feet and 82 feet cantilever. This allows a distribution of the fuel with ground storage of 140,000,000 lbs. of coal, 40,000,000 lbs. being under the trestle, with a bunker capacity of 1,000,000 lbs. near the old plant.

A two-ton bucket is used on the bridge delivering the coal to conveyors serving the boilers, these conveyors being also loaded when desired. An individual coal hopper is arranged for each boiler capable of holding 88,000 pounds of fuel or sufficient for nearly two days' operation with 20 pounds per square foot of grate. The accumulator is six feet nine inches in diameter outside of weights, which may be noted in the illustrations, together with the circulating water pump, vacuum air pump and other auxiliary apparatus.

COPPER MARKET SITUATION.

"The situation as regards the copper market shows a tendency to continued firmness, and there is no semblance at this writing of an immediate change in the character of the market," quotes "Copper Gossip," a publication published by the National Conduit & Cable Co. "There has been very little fluctuation in local quotations for a considerable time, and new business for several weeks did not figure up to the heavy transactions we were accustomed to hear of a few months ago. A fresh buying movement was started recently, however, which resulted in producers disposing of large quantities of copper for future deliveries. Latest sales include deliveries up to May and June. The market for distant futures now quotes 25¼ and 25½ for electrolytic wire bars, with lake as high as 26c for the best brands.

"If we are able to rightly gauge conditions we believe consumers of copper, to an extent more or less annoying, are compelled to operate their plants under disadvantages because of the inability to procure copper up to the level of their requirements during the next two or three months. There is no question but that some of the leading consuming interests deem it inconsistent with conservative methods and strictly sound business principles to run short-handed for the next ninety days, and at the same time jump into the market and load themselves up with copper at present prices, for which they cannot obtain delivery before the months of May, June and July. What the level-headed manufacturer specially wants is copper now wherewith he can fill his orders in February, March and April, and when April comes round he will be fully prepared to negotiate for his May, June and July copper on the market basis then current.

"Consumers of copper are in the position where they want to be reassured to a tolerably definite extent that everything possible will be done to prevent a scantiness in the supplies of raw material. This is necessary for the promotion of good and satisfactory business conditions. The present remarkable success of the entire copper mining industry is owing to the enormous demand for the product of the companies furnishing the metal, and every consumer is contributing his quota to the marvelous prosperity of the copper companies. We disclaim most positively any disposition whatsoever to make any rash or unmerited criticism on the methods of producing interests or to dictate what their policy should be, but we do believe the importance and magnitude of the establishments melting down copper in this country is such that they may rightly claim every reasonable consideration from those who have it in their power to adjust matters to prevailing conditions, so that the least possible hardship or injury will be done to the great and influential body of manufacturers dependent upon copper for from 75 to 90 per cent of their raw material."

Vancouver, B. C.—Prince Rupert, the Pacific terminus of the Grand Trunk Pacific, is soon to be connected with this city by wire. A. D. Smith will install telephone wires between all camps in the vicinity of the terminal points. They will also make connection with the Yukon telegraphs at Aberdeen.

SWITCHBOARDS.*

J. D. Ross.

In designing a switchboard for a large generating plant or substation, four things are to be sought for—safety of human life, reliability, flexibility, and simplicity. To secure safety and continuity of service the high voltage bus bars and switches should be in duplicate as far as possible, so that one set may be cut out for changes or repairs without interrupting service or requiring employees to work on live wires or apparatus. In all alternating work no dangerous voltage should be carried to any apparatus on the switchboard. All measuring instruments can be operated from series and potential transformers, while all switches or regulators of any kind can be operated by a remote control system. In this we are given a choice of three systems: Mechanical control, closed circuit electric control and open circuit electric control.

Mechanical control by means of rods and bell cranks or sprocket wheels has the advantage of being simple and reliable. Its main objection lies in its clumsiness and to reduce this to a minimum we must mass all switches and regulating devices close together to shorten the operating gear. The "closed circuit control" of switches by means of a closed circuit pilot system seems to have no excuse for existence until more reliable switches are designed. The "open circuit control" of switches by means of an open circuit pilot system is reliable and simple whether operated by solenoids or motors. The solenoid type is apparently the better at the present time.

In either system the main switch should follow the movements of the pilot switch on the board so that the operator may know by its position whether the main switch is in or out. Pilot lamps in addition operated from the main switch and placed beside the pilot switch make the system more complete.

Having now only electric connection between switchboard and apparatus we may allow more room for apparatus, lessening the chance of damage from short circuiting and allowing greater convenience for repairs. On the other hand the switchboard being free from heavy switch handlers and large cables may be very much reduced in size.

To make the switchboard still more compact all instruments, such as integrating wattmeters and curve tracing meters not required for actual operating, may be placed in another convenient location. All wires of dangerous voltage should be supported on angle iron rack work well grounded. By this means if the plant is designed so that working on live wires is necessary, there is no possibility of accident except by actual contact of a wire. All low voltage wires should also be on iron rackwork to avoid danger from fire.

After considering the above points I have designed several switchboards for various purposes. One is being installed at present for the distribution of alternating current at 2,400 volts for lighting and power. A description of this will best illustrate the points I wish to emphasize.

The feeder panel is 10 inches wide and 90 inches high.

Beginning at the top it is equipped as follows: One pilot lamp, one ammeter, one 6-point voltmeter plug, one Bristol Recording Voltmeter, one regulator push button, two pilot switches, one for each set of bus bars, four switch pilot lamps, one contact making voltmeter, two overload relays placed on sub base of panel A potential transformer is placed at the center of distribution and connected with the station through a pressure wire. The drop of voltage in this wire is compensated for in a small auto transformer and leads from this connect to the Bristol meter, the contact making voltmeter and one side of the six-point voltmeter receptacle. The other side of this receptacle is connected to a second instrument transformer in the station on the same circuit to take voltage readings in emergency if the pressure wire should break.

The contact making voltmeter raises or lowers the voltage automatically by controlling the regulator through a pilot system. As it and the Bristol meter are both connected to the pressure wire it is evident that the Bristol chart will be nearly a perfect circle if the inertia of the regulator is not too great for rapid motion.

A second winding from a series transformer in the circuit is placed on the contact making voltmeter to compensate for the drop in voltage due to C R losses. This is switched on with a double throw switch as an alternative in case of a breakage of the pressure wire. This makes practically a compensating voltmeter and where the power factor of the circuit is nearly unity, this arrangement will be almost as satisfactory as the pressure wire system.

The regulators are controlled by two clutches driven continuously in opposite directions from a shaft running the length of the rack work. The clutches are operated electrically by the contact making voltmeter. The shaft is operated from two small motors, one on either end. The two motors are connected one to each set of bus bars so that if one set is out, the shaft will still revolve. If both sets of bus bars are dead, due to accident, there is no need for the shaft for regulation.

We are arranging switches to be closed by this shaft by a magnetic clutch and to be held in place by a catch. The opening is done by a solenoid operating on the catch, both clutch and solenoid being controlled by the pilot switch on the board. This system is not carried out on the main switches, a closing and opening solenoid being used.

Overload relays are used on the circuits to close a contact in multiple with the pilot switch, used to open the feeder switch. All switches have their terminals connected under the oil, thus avoiding bare terminals and lessening the danger.

Each switch and regulator is in a compartment by itself and is separated at sides and back from its neighbor by barriers of sheet iron. Immediately above each is a small marble panel with flat stab switches so arranged that any oil switch or regulator may be cut out and removed at any time without interrupting the service. All wires are rubber and asbestos covered, and the bus bars are given a liberal insulation of empire cloth or linen tape boiled in paraffine to drive out the water and drained dry, the whole being then made fireproof by a taping of asbestos soaked in sodium silicate. Much of this work is done in our own shop.

I have not touched on direct current work, as that has been taken up in previous lectures under "Electric Traction," but have only attempted to outline some of the principles that should be studied to give the most successful operation of alternating current.

*Second lecture of Mr. J. D. Ross, to students in Electrical Engineering, University of Washington.

HIGH STEAM PRESSURE WITH MULTIPLE CYLINDER ENGINES.

Ten years ago there was much discussion among English mill engine builders as to the extent to which steam pressure might be advantageously raised with the consequent adoption of multiple cylinders. A number of triple and a few quadruple engines were put down, but for the last seven or eight years there has prevailed an increasing tendency toward compound engines working at 150 to 160 pounds, even for 1,800 and 2,000 horsepower capacities, as experience has shown that, while they have great advantages in point of simplicity and reliability, they can compete very closely in thermal efficiency, being actually the least expensive and most satisfactory type of engine to use.

LARGE GAS POWER PLANTS.*

C. E. Douglas.

The three principal prime movers available in this country for powers of 200 b. horsepower and over are the reciprocating steam engine, the gas engine, and the steam turbine. With the increasing adoption of electrical driving for the majority of industries, the low-speed steam engine is gradually being displaced, and, on the other hand, the scope of its high-speed rival is limited by the universal adoption of the steam turbine, especially for outputs of 1,500 b. horsepower and over. The author is of the opinion that even the most sanguine of gas engine builders prefers to limit the maximum size of his unit to somewhere in the neighborhood of this output, viz., 1,500 b. horsepower, although larger units are in operation. Except in the case of large power supply companies, city corporations, and a few isolated instances of large manufacturing works, the ordinary industrial unit ranges from, say, 200 to 1,500 b. horsepower, and therefore it is with the suitability or otherwise of gas plant for such installations that this paper deals.

The most weighty consideration which determines the adoption of one or other form of prime mover is reliability, combined with low cost of operation. No one dreams of questioning the reliability of the reciprocating steam engine; but is the cost of operation a minimum? There is an impression abroad that steam turbines are not so reliable as reciprocating steam engines. This impression may be unfounded, but the cost of turbine operation, in medium powers at any rate, is not less than that of high-class steam engines. What prime mover, therefore, is available to give power at a lower cost of operation? The gas engine is the only one which meets this demand. The critic will at once raise the question of reliability, but the author will endeavor to prove that, for industrial purposes, the gas engine, along with its supply plant, is at least sufficiently reliable to warrant a much extended sphere of operation, and that it can be operated with greater economy than any other form of power plant, at least within the limits stated.

It is an unfortunate but incontrovertible fact that the majority of power producers and users in this country are of opinion that the large gas engine is still in an experimental stage. The fact—and fact it is—that on the Continent large gas engines aggregating literally hundreds of thousands of horsepower are installed and in constant daily use, seems to leave the majority of British power users unmoved. It is perfectly true that a large majority of big gas engines on the Continent are working on waste gases from blast furnaces, but this is simply a matter of local conditions and convenience, and there is neither reason in nor proof of the assumption that a large engine is more reliable working with blast furnace gas than with producer gas. It is true that there is often considerable difference between these gases as to chemical and physical constitution, and blast furnaces gas is usually weaker than average producer gas in the proportion of, say, 90 to 145 b.t.u. per cubic foot. On the other hand, there have been working in this country for long periods engines of several hundred horsepower in one unit on waste gases from coke ovens, where the calorific value is often over 400 b.t.u. per cubic foot, and engines of 1,500 b. horsepower are being installed at the present time to work on such gas. The London County Council are installing several large engines of about 250 b. horsepower to work on town's gas having a probable value of 500 to 600 b.t.u., and in America there are instances of large engines running for long periods on natural gas, having a value of 1,000 b.t.u. per cubic foot.

Citing these cases shows that the value of the gas has nothing whatever to do with the satisfactory operation of the engine, provided, of course, that the value in any installation remains reasonably constant, that the engine is designed to suit the gas, and that the gas is suitably cleaned before admission to the engine. If successful and far-seeing firms like Krupp, who had one gas power station of some 12,000 b. horsepower in constant operation, decided only a year ago to instal two further units each of 1,600 b. horsepower, and like the Gutehoffnungshutte, who have year by year increased their gas engine plant to some 10,000 b. horsepower capacity; and if other large manufacturing concerns have done likewise, surely the case for the reliability of the gas engine is proved. If it is reliable abroad, what conditions either of manufacture, installation, or operation militate against its success at home? There is no question but that large gas engine builders have now learned in many cases through sad experience; but if experience is a hard master, the lesson may be well learnt with profit both to the builder and to the user. This state has been attained, and the installation of large gas engines and plant has definitely passed out of the experimental into the commercially profitable stage; there are numerous and authentic cases of large gas engines operating night and day continuously over long periods, with absolutely the same degree of steadiness and reliability as a steam engine.

Turning to the question of economy of operation, it is not sufficient to consider merely the usual station or working costs; we must also take into account interest and depreciation on capital outlay, because in most cases of large gas power plant this is somewhat greater than the outlay involved by a new steam station of equal capacity.

It is, perhaps, difficult to make a direct hypothetical comparison, because conditions vary so much and are so largely influenced by locality, but the author is confirmed in the belief that in spite of higher capital outlay the total generating costs, including interest and depreciation work, out in most cases distinctly in favor of the gas station.

Taking works costs alone, and assuming that we have proved the reliability of the gas plant, the items for wages, running stores, repairs, and maintenance differ little in the two cases, on the other hand even the most inveterate critic of the gas engine cannot deny its marked superiority as a heat engine over the steam engine. This means a substantial diminution of the heaviest item in works costs, i. e., the fuel bill. There is a further saving in that the stand-by losses in the case of gas are really very much less than in the case of steam; this has been proved over and over again. A gas producer only requires about one-twentieth of the fuel that is necessary in the steam boiler for banking fires overnight or during periods of light load. Mr. Dowson, in his recent book on "Producer Gas," has shown that on a 500 b. horsepower steam plant the stand-by losses have been assessed at 15 per cent. of the total fuel consumed in twenty-four hours, while the stand-by losses in a gas plant of equal capacity only amounted to 2 per cent. of the total coal consumed. These figures are substantiated by numerous other tests. In the case of municipal stations with a relatively low load factor, this point is of the utmost importance. Instead of having the continual and serious loss due to the condensation of steam in pipe ranges, we have the beneficial cooling of gas tending to increased efficiency and cleanliness. It is frequently stated that the heat efficiency of the gas engine on low loads is bad compared with the heat efficiency of the steam engine under similar loads. The curves shown in Fig. 1 give the comparison between the two, the figures in each case being based on actual results and not on assumption. We have therefore two factors making for economy with gas, first the actually lower fuel consumption per unit generated on continuous load (whether full or otherwise), and the substantial reduction in stand-by losses.

The table shown gives the published working cost of ten large municipal stations, and a diagram has been made from the averages of these showing that fuel alone amounts to half the total working costs. It is precisely this item which can be so substantially reduced with gas plant.

*Abstract of paper read Jan. 22, 1907, before the Manchester Section of the I. E. E.

Name of Borough.	Type of Engines.	No. of Units sold per annum.	Cost in Pence per Unit Sold.					Load Factor. Units x 100. / Max. L. x Hrs.
			Coal and other Fuel.	Oil, Waste, and Stores.	Wages.	Repairs and Maintenance	Total Works Cost.	
Liverpool	Reciprocating	31,452,323	.27	.04	.11	.08	.50	22.7
Bradford	"	13,733,651	.23	.04	.07	.27	.61	24.5
Edinburgh	"	12,914,119	.28	.04	.06	.16	.54	16.8
Leeds	"	9,197,259	.18	.02	.09	.19	.48	15.6
Bolton	"	6,055,551	.26	.04	.10	.11	.51	21.4
Blackburn	"	3,331,460	.30	.08	.17	.09	.64	16.75
Coventry	"	2,522,100	.27	.02	.13	.16	.58	18.7
Bootle	"	2,292,974	.25	.03	.15	.14	.57	21.25
Dudley	"	1,611,500	.37	.08	.10	.08	.63	13.5
Govan	"	1,602,606	.24	.05	.16	.12	.57	16.4
		Average..	0.265	0.044	0.114	0.140	.56	

Average works cost per unit sold in electricity works (lighting load).

As to capital cost, a close examination of completed and carefully projected installations generally shows that if a new steam station is to be installed on the most economical lines, and is equipped with coal handling plant, economisers, feed heaters, superheaters, possibly water purification plant, oil separators, and surface condensers, the total cost of the installation, including buildings, foundations, and chimney, is not far short of the cost of installing gas. It is not necessary to provide a house for the gas producing and cleaning plant, except in so far as it may be necessary to erect a corrugated iron screen or roof to shelter the men when they have to work on top of the producers. In the evidence before the Royal Commission on Coal Supplies, it was stated that the complete large power gas installation might cost some 10 per cent. more than a complete and highly efficient steam plant of equal capacity; this estimate was based on actual installation figures. As a matter of fact the author has authentic figures from which it appears that the total cost of some gas engine installations is actually less than that of steam plant, each complete in every respect.

While gas plant can be installed to drive electrically or direct, in most cases it will be obvious that locality and existing conditions govern to a large extent a decision as to the installation. For large powers it is only in rare cases of special convenience—and generally these are municipal—that town's gas can be used, on account of the relatively high cost of the same compared with producer gas; the former would require to be delivered to the consumer at a figure well below 1s per 1,000 cubic feet, to compare with the cost of the latter.

We, in the British Isles, are the fortunate possessors of large supplies of excellent coal for power gas purposes; and whether that coal be anthracite or bituminous (provided that, if the latter, is be a non-caking variety) there are now many excellent producers, or generators, as they are sometimes called, which will efficiently gasify such coal. In Scotland and in the North and Midlands of England, many non-caking coals are available; and as far as calorific value is concerned, the resultant gas is reasonably uniform, ranging, under certain conditions of operation, from 130 to 170 b.t.u. per cubic foot, by calorimeter. Some of the coals are exceedingly soft, with the result that much tar is produced and extra cleaning plant must be installed to cope with it. Caking or coking coal is inadmissible, because, though its gas-producing qualities may be as good as those of non-caking coal, it is physically impossible to work it, as the coal forms a sticky mass which chokes the producer. Coke is also, in many cases, applicable for producer purposes; but modern gas-works coke is often insufficiently carbonised, with the result that as much tar is produced as though soft bituminous coal were used. Anthracite is an ideal fuel to use; but excepting where it can be obtained in reasonable proximity to the site of the plant, as, for instancee, in the South and Southwest of England and Wales, its cost generally precludes its use, except for small plant. The amount of tar produced and consequently the extent and cost of the gas-purifying plant required, is a minimum.

On the Continent and also in America, briquettes, lignite, peat, wood, and charcoal are all employed successfully; and in most of our Colonies as well as in the far continents, coal suitable for producer purposes is now being worked. Regarding the producers themselves, these are classified according to whether the air and steam required for the formation of the gas are drawn through the bed of the fuel by the action of the engine, or whether they are forced through by an independent blower; thus we get the suction and the pressure producer respectively.

It will be seen that the coal supply available is practically the first consideration; and that the higher the price of coal the greater the saving to be effected by gas. In one works near London the proprietors of a mill burned anthracite (costing about 20s. per ton) under their boilers, in order to prevent smoke nuisance in a densely-populated district; they installed a gas engine of 500 b. horsepower to replace their steam engine, and a producer plant to gasify bituminous coal was put in. In this case, in addition to, let us say, at least halving the amount of coal formerly used by the steam plant, the price of the coal per ton was practically halved as well, so that the original fuel bill is now reduced by about 75 per cent.

Another point which is of great importance is the question of water supply. The water consumption of gas is much below that of steam plant; taking irrecoverable water alone—i. e., that used for raising steam—in the first place to generate gas, and in the second to supply steam engines, about one and a half pounds of steam are required per horsepower-hour with gas engines, while we can safely take 15 pounds of steam per horsepower-hour as being required for condensing steam engines. For auxiliary purposes the amount of water required varies in both cases. In a paper read before the Institution of Engineers and Shipbuilders in Scotland on the 20th of November last year, Mr. Hugh Campbell stated that for suction gas installations, the total quantity of water required, both for raising steam and purifying gas, is from one and a half to two gallons per b. horsepower-hour. This statement evoked lively criticism, but one firm of producer makers gives a figure of only 600 gallons per hour for a 1,500 b. horsepower producer; another firm works on the assumption that six gallons of water per b. horsepower-hour are sufficient for all producer purposes. In addition to the water for the producer, water is required for the engine jackets. Some makers do not water-jacket the pis-

tons of lower-power engines; but assuming these to be water-cooled, let us allow that 12 to 15 gallons per b. horsepower-hour is sufficient for all engine and producer purposes. For condensing purposes in this country, an average figure for circulating or injection water is 35 times the weight of steam condensed, in the case of the steam plant, therefore, 52.5 gallons are required as against a maximum of 15 gallons for the gas plant, and taking the irrecoverable water as well, we get a ratio of 54 to 15. In the case of steam turbines requiring a high degree of vacuum, the proportion will generally be much higher. This is important, and if the water supply be unfit for use in boilers without purification, it is quite clear that the gas plant scores still higher. With regard to the works cost items of wages, stores, repairs, and maintenance, the gas plant and engine do not involve any more skill or more attendants than steam plant, especially when all auxiliaries are taken into account. The producer requires no more skill than a boiler, and an unskilled man or ordinary attendant can as easily run a gas engine as a steam one. As a matter of fact, there is nothing to choose between the items of wages and running stores for the two plants, and while it is certain that in the earlier days of large gas engines, whatever the type, the repairs and maintenance account was exceptionally high, it is equally certain that this item is now but little, if any, higher than in the case of the steam engine. As regards the producers, this item is undoubtedly much less than for boilers, so that in the long run the balance is even between the two. One word about lubrication, which is popularly supposed to be excessive in gas engines—provided the lubricating arrangements are well carried out and a minimum amount of oil is applied at proper points, there is no cause to fear a heavier consumption than with steam engines.

The suction producer is certainly by far the cheapest to instal, consisting, as it usually does, of three elements only—the producer proper generally containing the boiler or vaporiser into which a small quantity of water is fed, and from which it is taken as steam to the fire-grate; the coke scrubber, used for cooling the gas and taking out the heavier dirt and tarry matter; and the sawdust cleaner for effecting final purification: this description is common to all suction producers except that the elements may be arranged somewhat differently.

The pressure producer for bituminous coal is a more expensive generator to instal on account of the large proportion of volatile hydrocarbon which is distilled from the coal as tar, and must be removed if the engine is to run satisfactorily. The presence of tar in the gas is not only prejudicial because it clogs up the cleaning plant, as well as the internal valve mechanism and other parts, but also because of the trouble which arises if particles of tar get lodged inside the cylinder. They incline to remain incandescent and ignite the incoming mixture at the wrong time, and also form an exceedingly hard carbonized scale, which tends to wear both cylinder and piston. Sulphur in the gas is most detrimental; it does not occur to any extent, as a rule, but if it does, and water be present, there is always risk of corrosion. Some cokes and some Continental anthracites have this objectionable qual'ty, but, generally speaking, it does not often occur in British coal.

As to regularity of turning moment of gas engines, the difficulties of this have generally been overcome; they certainly did exist, sometimes in a most marked degree, with the old single-acting type of engine; but there are double-acting two-cycle gas engines coupled direct to and driving three-phase fifty-cycle alternators in parallel with perfect synchronism, which the author has seen, and he has actual knowledge of other similar gas engine sets running in parallel with each other and with steam-driven alternators.

The author concludes with a summary of actual results substantiating the foregoing remarks concerning reliability and economy. These include:

A plant consisting of two engines capable together of giving 500 electrical horsepower continuously at the switchboard. The calorific value of the bituminous coal used during three recent tests, each of twelve hours duration, averaged 12,250 b.t.u. per pound, and the gas varied between 140 and 152 b.t.u. by analysis. The fuel consumption in the producer averaged 1.3 lb. per kilowatt-hour, a most remarkable result. The engines have run for many weeks continuously, with rare stoppages, from 7:30 a. m. on Monday, till noon on Saturday, and operate in parallel with steam-driven sets situated in another engine room.

The engineer states that the cost per kilowatt-hour works out distinctly cheaper than if produced on the high-speed steam plant, in spite of the fact that the capital charges per unit on the gas plant are distinctly higher than they will be when it is brought up to its full capacity of 1,000 e. horsepower.

From a large iron works in the Midlands, the manager writes:—"It may interest you to know that formerly (with steam) we used about 2,000 tons of coal, costing us about £1,020 per annum, whereas now (with gas engines and bituminous coal pressure plant) we are using about 326 tons, costing about £195." This means a reduction to one-fifth of the original fuel bill; but it is only fair to point out that the old steam engine plant was admittedly uneconomical.

In another case, where a 500 b. horsepower gas plant replaced a steam plant of equal capacity, the saving is one-third of a penny per b. horsepower-hour, which, at ten hours a day and 300 days a year, is equivalent to about £2,000, notwithstanding the fact that a greater amount is allowed for depreciation on the gas engines than was allowed for the steam.

Several tests were carried out on a gas plant aggregating about 1,000 horsepower. The engines have been driving dynamos for some time now, and the results showed that the fuel (Yorkshire) gasified per kilowatt-hour was 1.43 lb. on full load and about 1.47 on three-quarter load.

The following two cases are from Mr. Dowson's interesting work on "Producer Gas." At the Birmingham Small Arms Factory, with a 250 b. horsepower plant, the total fuel consumed was 1.9 lb. per kilowatt-hour, and the total water used in the gas plant (not the engine) was one gallon per kilowatt-hour. At the Hoffman Manufacturing Company's Works, at Chelmsford, a test run of 123 hours was made without a stop, and readings were taken every half hour. The consumption of anthracite peas in the suction producer worked out at 1.23 lb. per kilowatt-hour.

At the Guernsey Electricity Supply Company's station, visited about two years ago, and which at that time was run at very light load, the figures for total working cost come out to practically 0.5d. per unit.

In a works where a 270 b. horsepower gas engine was installed at the beginning of last year, the gross coal consumption, taken over ten days on irregular load, and including stand-by losses, worked out at about 0.9 lb. per b. horsepower hour on an average of about three-quarter load. This engine is driving a mill, but if it were driving a dynamo having 93 per cent. efficiency, you will see that this works out at under 1.3 lb. per kilowatt-hour. In this case the gas plant consumes from one-sixth to one-seventh of the coal formerly used in the steam plant; but the latter was not of modern or economical design.

In another and larger plant, the total generating costs work out, on three months' ordinary running, at 0.135d. per unit, probably the lowest actual working costs on record. The load is certainly steady and continuous; but to even double or treble this figure, to contrast the running of this plant with one having the load-factor of an average Corporation station, one gets a generating cost much below that of any steam station having units within the limits of size which we have been discussing.

Individual tests on gas plant for short periods are perhaps unconvincing, especially, of course, with regard to reliability. They are, however, directly comparable with similar

tests on steam plant as far as coal consumption goes. The author has certified reports of the following: 1.43 lb. of coke per kilowatt-hour; 1.23 lb. anthracite per kilowatt-hour, with a further test on the same plant of 1.29 lb. per kilowatt-hour, and seven and a quarter gallons of total water consumed per b. horsepower-hour; another of 1.03 lb. coke per b. horsepower hour, and so on. On a 350 b. horsepower gas plant driving cement works in Germany, 1⅓ lb. of very low grade lignite briquettes were used on a long test run per b. horsepower-hour.

Finally, there are the results of operating the Schwerin Electricity Works, where two 350 b. horsepower gas engines are used for driving direct-current machines for lighting. Taken over the whole first year of operation the gross coal consumption, including all losses and stand-by charges amounted to 2.2 lb. per kilowatt hour, while during the first six months of 1906 the average gross coal consumption per unit generated not on specific tests, but in actually weekly running, was 1.9 lb. per kilowatt hour, and that on a very poor load factor.

THE MUSIC OF ELECTRICITY.

" 'We are merely at the threshold of the door leading to wonders in the world of science undreamed of to-day,' said Mr. Edison a couple of years ago. 'This period will go down in history as the guessing age in the realm of electricity.'

"Even while Mr. Edison was saying this, a wonderful invention, giving to the world the music of electricity, was in process of perfection at Holyoke, Massachusetts," states the "Electric City.

"The telharmonium, the latest invention in the electrical and scientific field, is a remarkable combination of new dynamos, transformers, wires, transmitters and keyboard, producing perfect music. Dr. Thaddeus Cahill, in his invention, has practically realized the dream-prophecy of Edward Bellamy in his 'Looking Backward,' by building a plant which will supply music to thousands of halls, homes, churches, hotels, offices—the list is limitless—by simply turning a switch, even as described by Mr. Bellamy:

" 'She, crossing the room, merely touched one or two little screws, and at once the room was filled with the music of a grand organ anthem; filled, not flooded, for by some means the volume of melody had been graduated to the size of the apartment.

" 'Such music, so perfectly rendered, I had never expected to hear.

" 'As she spoke, the sound of violins filled the room with the witchery of a summer night. When this had ceased, she said:

" ' "There are a number of music rooms in the city, perfectly adapted accoustically to the different sorts of music. These halls are connected by telephone with all the homes of the city whose people care to pay the small fee, and there is none, you may be sure, that do not.

" ' "The corps of musicians attached to each hall is so large that, although no individual performer, or group of performers, has more than a brief part, each day's programme lasts through the twenty-four hours." '

"And now to turn from fiction to fact; from the poetry of the imaginative novelist to the performance of the creative inventor. While the system of the telharmonium may seem complex, it is, like all other great innovations, based on simple principles. Moreover, the telephone, by means of which the music is brought to the audience or the individual listener, has been familiar to the public for thirty years, and has become, with all its wonderful ingenuity, one of the essential commonplaces of modern civilization.

"The Cahill telharmonium has a range within which all other instrumental music is encompassed, yet presents a new music, all its own. The performer at its keyboard, instead of playing upon the flowing air in the sympathetic pipes of an organ, plays upon the electric current generated in a number of small dynamo-electric machines of the alternating-current type, each, so to speak, corresponding to a pipe. These are all mounted together on one shaft, which is revolved by an electric motor, thus securing steadiness at a high speed. The current in the circuits of these little 'inductor' alternators surges to and fro at a very considerable rate of 'frequency,' analogous to vibration, and each alternator is so designed as to have a characteristic vibration of its own. Thus, the middle C on the piano is produced by the vibrations of the string that is struck, and those vibrations are always 256 per second. In the telharmonium there is one dynamo, whose alternating current vibrates at just that rate, and when heard in the telephone, the current gives the note known as middle C always, and all the time, so long as the telephone remains in circuit. But in order to enjoy a musical composition, we want to hear not simply one note, but other notes, softly or loudly played, long-sustained or crisply-touched, and so the circuits from the dynamos are all brought to the keyboard, where the performer, just as though he controlled a number of valves or gates, lets in or shuts out the currents he needs, and of course only those thus introduced into the telephone circuit are the ones heard.

"Further, each note in music has, as is well known, its enriching vibrations in multiple of the fundamental number, so that one 'harmonic' will be the result of 512 vibrations, or twice 256, and the next higher will be one of 1,024; and so on through the octave. Obviously all this is easy to reproduce in the alternations of current, so that by means of these dynamos one has command of all the complexities and interweavings of tone color—the ability to analyze, synthesize, separate, blend. The performer, subject only to the limitations of his own skill and temperament, is at liberty to impress upon the surging waves of current the ebb and flow of his most intimate emotion, as he can do with no other medium of sound production. With the telharmonium he not only can suppress at will by omission, when not required by texture of sound, even the fundamental note, but can select by fine inclusion the subtlest overtones, as a basis for his innermost art of tone building.

"Yet another beauty of perfection emerges as this unique invention is studied—the wonderful quality of the tone, a tone absolutely pure, and soft and rich; a delight to the ear, and a rest for tired nerves. Hitherto in telephonic reproduction of music, the notes of the piece, played at one end of the line, have had to be taken up by the telephone transmitter, and, after passing through the circuit as undulatory waves of current, be again transformed into music at the receiving end. This has involved serious irreparable loss in volume. purity and beauty. But, in the telharmonium, the reproducing is also the performing instrument; its undulatory waves of current are themselves the 'music of the spheres' generated by the little dynamos. There is admittedly great beauty in the music from a phonograph or graphophone record, but that again is reduced and altered by the processes it goes through. As compared with telharmonium music it is but 'canned goods,' instead of coming fresh from orchard or garden. At each use, the edge wears off the phonograph cylinder, as it does off a coin in circulation, but with the telharmonium each new production of wave current and sound is as vivid and original as its predecessor, and can never be otherwise.

"And then—greatest fact and cause of wonder—is the ease with which this music of the telharmonium is deliverable instantaneously and simultaneously at ten or twenty or thirty thousand places, from the same central music plant.

"Think of the audience thus brought within reach of one human being! At best, an orator, an opera singer, or a pianist can sway but a few thousand people, and the average audience is only a few hundred. But the telharmonist, in addition to the audience that may chance to be in the room

where he is playing, reaches out over the pulsing wires to a hundred thousand, five hundred thousand, a million persons, all able to hear him at once, and while he may not shake the ground, as does deep-toned Niagara, he can make square miles of humanity respond to his tender and melodious tones. Here the music enlivens a dinner party, elsewhere it assists at a wedding; not far away it soothes pain in the house of suffering; while all over town, innumerable homes will be brightened and made cozier by the 'music on tap.'

"Mr. Andrew Carnegie has an organist play while he takes his morning bath. Soon every citizen may turn on his music at the moment he rises; and at night the same soft sounds will soothe him to slumber after he has turned off the light. All this may sound fanciful, but the telephone that was derided as a toy is now in countless numbers of homes and offices between Coney Island and Golden Gate, and millions of people can talk with each other. Over every one of those same wide-flung circuits the music of the telharmonium is feasible and possible."

THE USE OF ALCOHOL AND GASOLINE IN FARM ENGINES.*

Sources of Power.

There are two great sources of power and an infinitely varied series of mechanical devices and machines for the generation of power. Water power always has been used and probably always will be used so long as the rain falls, but it is insufficient for our present needs or geographically unavailable. The greatest source of power is fuel. Fuels may be divided into two series—those that now exist in the form of natural deposits and those which are being produced continuously. All of the coals, hard and soft, with the lignites and peats, the crude oils and natural gas, exist in the form of deposits; and, while it is true that the decay of vegetable matter may be today forming more deposits of the same nature, it is equally true that we are using the present supply faster than the rate of production. The newest fuel for power purposes is alcohol. This is made from the yearly crops of plants. There is in existence no natural deposit of alcohol, but in a sense it may be said to be possible to produce inexhaustible supplies.

It is only within recent time that engineers have known how to build engines that would produce power from alcohol; and still more recent is the further discovery by engineers that this power can be produced at a cost which may permit its general introduction.

By far the largest part of the power now being used comes from steam produced by the use of coal. This is chiefly due to the fact that as a rule whenever it can be used it is cheaper than possible substitutes, although it is partly due to the fact that steam power is better adapted to some classes of work and is older and better known than power generated by the gas engine in its varied forms. In point of present use, water power stands next to steam in importance. This is largely due to the fact that water power is among the earliest in point of development, but more largely to the fact that it has become possible to transform water power into electrical power, which can be transmitted long distances, and so overcome geographical isolation of the sources.

Next in quantity produced stands power generated by the gas engine. This class of engines includes all machines in which the fuel mixed with air is burned or exploded within the working chambers, whether the fuel be gas produced from coal, natural gas, vapors of any of the mineral oils, vegetable or animal oils, or alcohol. The subordinate position occupied by this source of power is due partly to the fact that engineers have only recently discovered, and are today discovering, how best to build these machines and adapt them to the work they are to do. Wind and wave power stand at the foot of the list and always will, so far as quantity of power developed is concerned. This is because of the irregularity of the sources of supply and their comparatively feeble nature.

*Abstract from Farmers' Bulletin No. 277, issued by the U. S. Department of Agriculture by Chas. Edward Lucke and S. M. Woodward.

Comparative Cost of Power From Different Sources.

The cost of producing power from any of the above sources is made up of a number of items, including interest on the first cost of the installation, depreciation of the apparatus, its insurance, etc., usually called the "fixed charges." To these should be added the costs of fuel, of labor for attendance, and of repairs, as the principal items, and the cost of lubricants, material for cleaning, and a great many other small miscellaneous items, all going to form what are commonly called "operating charges." In all cases where fuel is used its cost is, if not the most important, certainly a very important item. In the case of water power, where the fuel element is zero, the advantage is offset by an interest charge on the cost of installation for dams, pipes, tunnels, shafts, etc. Assuming that power from all of these different sources is equally well adapted to the particular work to be done and equally available, then that system will be selected for any particular case for which the cost of power is least. Leaving out of consideration water power, it is found that the labor costs do not differ nearly so widely for the different systems, nor are they so large, as the fuel cost. Therefore, the great question today in power production as regards immediate cost of power and maintenance is this lowering of the fuel cost.

The cost of fuel per unit of power developed depends, first, on the market price of that fuel at the point where it is to be used, and next, but by no means least, on the ability of the machinery to transform the fuel energy into useful work. If all the different kinds of machinery used for power generation could turn into useful work the same proportion of the energy in the fuel, coal would be almost universally used, because of the present low cost of energy in this form.

Comparative Cost of Energy in Different Fuels.

The different kinds of fuel contain different amounts of energy per pound—that is to say, they have different heating powers. Heat energy is measured in terms of a technical unit called by English-speaking people the "British thermal unit" (B. T. U.). This unit is the amount of heat that will raise the temperature of 1 pound of water 1 degree on the Fahrenheit thermometer. In comparing, therefore, the value of fuels for power purposes there must be taken into consideration two facts—the market price of the fuel and the amount of heat which will be liberated when it is burned. Anthracite coal in the neighborhood of New York can be bought in small sizes in large quantities for power purposes at about $2.50 per ton. This coal will contain about 12,500 B. T. U. per pound. This is equivalent to about 10,000,000 heat units per dollar. Large sizes, such as egg coal, containing about 14,000 B. T. U. per pound, can be bought in large quantities for about $6.25 per ton, which is equivalent to 4,500,000 B. T. U. per dollar. Other grades of anthracite coal and the various grades and qualities of bituminous coal will lie between these two limits of cost. Illuminating gas in New York costs $1 per 1,000 cubic feet, which is equivalent to about 500,000 heat units per dollar. Natural gas in the Middle States is sold for 10 cents per 1,000 cubic feet and upward. This fuel at the minimum price will furnish about 10,000,000 heat units for a dollar. Crude oil sells in the East at a minimum price of 4 cents per gallon, which is equivalent to about 4,000,000 heat units per dollar. Gasoline sells at a minimum price of 10 cents per gallon, which is equivalent to about 1,200,000 heat units per dollar. Kerosene sells from 10 to 30 cents per gallon, which is equivalent to 1,200,000 and 400,000 heat units per dollar, respectively. Grain alcohol,

such as will be freed from tax under the recent legislation, will sell for an unknown price; but for the purpose of comparison, assuming 30 cents per gallon as a minimum, it will give 270,000 heat units per dollar. Gasoline, kerosene, crude oils, and, in fact, all of the distillates have about the same amount of heat per pound; therefore, at the same price per gallon, ignoring the slight difference in density, they would deliver to the consumer about the same amount of heat per dollar, whereas the other liquid fuel, alcohol, if sold at an equal price, would give the consumer only about three-fifths the amount of heat for the same money. From the figures above given it appears that the cost of heat energy contained in the above fuels, at the fair market prices given, varies widely, lying between 200,000 heat units per dollar and 10,000,000 heat units per dollar. It is possible to buy eight times as much energy for a given amount of money in the form of cheap coal as in the form of low-priced gasoline, or twenty-five times as much as in the form of high-priced gasoline or kerosene. This being true, it might seem to a casual observer as rather strange that gasoline should be used at all, and the fact that it is used in competition with fuel of one-eighth to one-twenty-fifth its cost shows clearly that either the gasoline engine has some characteristics not possessed by an engine or plant using coal, which makes it able to do things the other can not do, or that more of the heat it contains can be transformed into energy for useful work. Both of these things are true.

Thermal Efficiency.

As was pointed out before, the different kinds of machinery used to generate power render more or less of the fuel energy into useful work; all systems do not give equal returns for equal amounts of heat supplied. If all the heat energy in fuel were transformed into work with no losses whatever in the mechanism, the machinery would be said to have a thermal efficiency of 100 per cent, and it would require 2,545 heat units per hour to maintain an output of 1 horsepower. If half of the energy in the fuel were lost in the machinery, its thermal efficiency would be said to be 50 per cent, and there would be required 5,090 heat units per hour. If only 1 per cent of the heat energy in the fuel were transformed into useful work, the efficiency of the machinery or power plant would be said to be 1 per cent, and there would be required 254,500 heat units per hour to maintain 1 horsepower.

Steam plants in use represent a great variety of styles or types, but in general it may be said that the more complicated and refined the plant and the larger its size the more efficient it is, because the complication exists only as evidence of an attempt to minimize the losses of heat in the machinery. Similarly the more steadily the plant works at the output for which it was designed the higher the efficiency of the plant, and conversely, the smaller the plant, the simpler the apparatus, or the more intermittently it works, the lower its efficiency. Steam-power plants are built today to do every conceivable sort of work, and range in size from 1 horsepower to 100,000 horsepower. For purposes of comparison neither the largest nor the smallest should be used, nor the best performance nor the worst performance of these plants, but a figure representing a fair average for the conditions named should be taken. Large steam plants in their daily work seldom use less than 2 pounds of poor coal per hour for each useful horsepower (known as a brake horsepower), which is equivalent to about 25,000 B. T. U. per hour, and which corresponds to about 10 per cent thermal efficiency. Small steam plants working intermittently, such as hoisting engines, may use as high as 7 pounds of coal per brake horsepower, which is equivalent to about 100,000 heat units per brake horsepower hour, or 2.5 per cent thermal efficiency. Some plants will do better than the above with proper conditions, and some may do worse, but in general it may be said that the performances of steam plants lie between the limits of 2.5 and 10 per cent thermal efficiency.

Plants consisting of gas producers for transforming coal into gas for use in gas engines have in general a much

Cost of Energy in Fuels.

Kind of fuel.	Cost of fuel.	British thermal units. (B. T. U.)	Number of B. T. U. bought for $1.
Small anthracite	$2.50 per ton	12,500 per pound	10,000,000
Large anthracite	6.25 per ton	14,000 per pound	4,500,000
Illuminating gas	1.00 per 1,000 cubic feet	550 per cubic foot	550,000
Natural gas	.10 per 1,000 cubic feet	1,000 per cubic foot	10,000,000
Crude oil	.04 per gallon	20,000 per pound	3,650,000
Kerosene	.10 per gallon	20,000 per pound	1,200,000
Do	.30 per gallon	20,000 per pound	400,000
Gasoline	.10 per gallon	20,000 per pound	1,200,000
Do	.30 per gallon	20,000 per pound	400,000
Grain alcohol	.30 per gallon	12,000 per pound	270,000
Do	.40 per gallon	12,000 per pound	200,000

Fuel Cost of Power.

Fuel and type of plant	Fuel required per horsepower per hour.	British thermal units required per horsepower hour.	Thermal efficiency.	Cost of fuel.	Cost of fuel per horsepower per hour.
Anthracite coal:			*Per cent.*		*Cents.*
Large steam plant	2 pounds	25,000	10	$2.50 per ton	0.25
Do	2 pounds	25,000	10	6.25 per ton	.57
Small steam plant	7 pounds	100,000	2½	2.50 per ton	1.00
Do	7 pounds	100,000	2½	6.25 per ton.	2.20
Producer gas plant	1¼ pounds	14,000	18	2.50 per ton	.14
Do	1¼ pounds	14,000	18	6.25 per ton	.31
Do	2 pounds	25,000	10	2.50 per ton	.25
Do	2 pounds	25,000	10	6.25 per ton	.57
Illuminating gas	24 cubic feet	12,000	20	1.00 per 1,000 cubic feet	2.20
Crude oil	1.4 pints	25,000	10	.04 per gallon	.68
Gasoline	1.1 pints	13,400	19	.15 per gallon	1.70
Do	1.1 pints	13,400	19	.30 per gallon	3.40
Alcohol			*a*19	.30 per gallon	5.00
Do			*a*19	.40 per gallon	6.70

*a*Efficiency of alcohol is assumed to be the same as that of gasoline for identical conditions of use.

higher thermal efficiency than steam plants doing the same work. They are, however, not built quite so small as steam plants, the smallest being about 25 horsepower, and in general they have not been built so large, the largest being only a few thousand horsepower. Their efficiency, however, does not vary so much as is the case with steam plants. It may be fair to say that under the same conditions as above outlined these plants will use 1¼ to 2 pounds of coal of fair or poor quality per brake horsepower hour, which gives a thermal efficiency ranging from 18 to 10 per cent. These plants can be made to do much better than this, and perhaps may do worse, although the variation is not nearly so great as for steam plants.

Gas engines operating on natural gas or on illuminating gas from city mains will, on fluctuation of load with the regular work, average about 12,000 heat units per brake horsepower hour, or 20 per cent thermal efficiency. Exploding engines operating on crude oil will average about 25,000 heat units per brake horsepower hour, which is equivalent to about 10 per cent thermal efficiency. Exploding engines using gasoline should operate at a thermal efficiency of about 19 per cent under similar operating conditions.

The efficiency of an alcohol engine may be assumed at this time to be unknown, but as alcohol can be burned in engines designed for gasoline, it may be assumed that such an engine will have with alcohol fuel the same thermal efficiency as with gasoline, to-wit, 19 per cent for fair working conditions.

From the above brief discussion of the efficiency of different methods of power generation from different fuels it appears that quite a range is possible, though not so great a range as exists in the case of cost of fuel energy. Efficiency is seen to lie somewhere between 2½ and 20 per cent for all the fuels under working conditions. It is known that actual thermal efficiency under bad conditions may be less than 1 per cent and under the best conditions as high as 40 per cent, but these are rare and unusual cases. The range given is sufficient to indicate that a highly efficient method may make the fuel cost per unit of power less with quite expensive fuel than it would be with cheaper fuel used in a less efficient machine. It is also perfectly clear that without proper information on the efficiency of the machine or the efficiency of the plant it is impossible to tell what the cost of fuel per horsepower hour will be, even though the price of the fuel per ton or per gallon be known. From the figures given on the cost of fuel and a fair average for plant efficiency the cost of fuel per horsepower hour is computed as given in the preceding tables:

Adaptability of Various Types of Engines.

The foregoing table shows very clearly that the cost for fuel to maintain a brake horsepeower for one hour varies widely, and at the prices given the dearest costs nearly 48 times as much as the cheapest. The fact that not everybody uses the fuel giving the cheapest power in point of fuel cost, but that even the most expensive finds a ready market, makes it clear that there must be good reasons. These reasons may be found in local variations in price of fuel, in differences in adaptability of the engines to the work required, and in the fact that the above figures show fuel cost only, whereas there are great differences in the cost of attendance. An elaborate steam plant, to be even fairly efficient, must be continuously operated at fairly heavy load; intermittent working or working at a decreased output makes them wasteful of fuel. Moreover, the apparatus is so complicated, slow to start up, and dangerous to life and property in careless or inexperienced hands that persons must become skilled by years of study and practice before they may be allowed the handling.

The gas engine with its producer can handle today the same kind of coal that is used in steam plants, and yet the weight of this apparatus and its lack of flexibility, compared with steam engines, make it unavailable for steamships and locomotives; so it is clear again that adaptability to service is even more important than the cost of fuel. Similarly, gas-producer plants have not yet been successful for sizes smaller than 25 horsepower, and especially unsuccessful have they been so far for intermittent work. For the small sizes the steam plant is also very wasteful of fuel, requires a skilled operator, and is slow in starting; so it is clear why engines burning crude oil, gasoline, kerosene, and other liquid fuels explosively should be used for light work in isolated stations where the work is intermittent and where quick starting and small care in attendance are essential. In this connection it must not be forgotten that a kerosene, gasoline, or crude-oil engine can be started in a few minutes and can even be left running for practically a whole day with only an occasional examination to see that the oil cups are flowing properly and the bearings are not getting hot through being dirty. Steam engines with their boilers, on the contrary, can not be started inside of one or two hours, and all the fuel necessary to raise steam is wasted so far as the work to be done is concerned. Moreover, a steam engine requires continuous feeding of coal and close attention, so that a man must be always near it, having no other duties but its care.

In the natural-gas regions a large number of gas engines are working and in the oil regions a similar number of oil engines and gasoline engines, because the nearness to the supply makes the fuel cheaper than transported fuel, and the exploding engine is more efficient than the steam engine.

It thus appears that in spite of the fact that the fuel element in the cost of power is high for engines burning crude oil, kerosene, and gasoline in comparison with those using coal, at the same time they possess advantages that do not exist in steam plants and gas-producer plants, which give them a very distinct field, as indicated by the following uses to which these engines are being put today: Driving boats, automobiles, and railroad motor cars; pumping water for private houses, for farms, for irrigation, and in some cases for municipal service in small towns; compressing air for drilling, hoisting, riveting, etc.; operating small carpenter shops, machine shops, forge shops, and, in fact, any kind of small shop; operating ventilating fans in buildings and in mines; running small factories, such as creameries and butter factories; operating feed-cutting and grinding machinery, corn shredders, and threshing machines; operating other special machines, such as ice-cream freezers, printing presses, mostly small in size, and making electric light in isolated localities. Not only is this field a real one, but it is a large one, as is shown by the number of these small engines being sold today. The exact figures on the sales are not available and it is impossible to secure them because of the unwillingness of manufacturers to tell their business; but when a single manufacturer (as is the case) is selling 425 per day, and there are in the United States alone some 300 manufacturers of importance, there can be no doubt as to the popularity of these machines.

Alcohol at a price unknown now becomes available for use in engines, whose peculiarities are not fully known and whose ability to transform heat into work is correspondingly in question. If the alcohol engine can be shown to have an efficiency as high or higher than other liquid-fuel engines and be similar in type and characteristics, it can do all they can do, and its field will be the same as their field in spite of fuel costs; but by field is meant the nature of the work rather than the geographical location. It is likely that the alcohol engine will find as favorable a geographical location as the natural-gas engine and the oil engine have near the source of supply and far from the source of competing supply. But should it appear that the alcohol engine can do more or better work than its oil or gasoline competitors, its field will be wider. In any case the position which the alcohol engine may take today is no criterion as to its future, because it will operate on a source of energy or fuel supply which, as

pointed out, is inexhaustible, whereas the supply of both crude oil and its distillates may ultimately become exhausted.

The determination, then, of the position of the alcohol engine today involves a forecast of the future, and should it be shown to be able to compete now it must inevitably reach a stronger and more important industrial position as time goes on. This is the fact that has led governments to take up the question, and among them the United States is the latest.

First Use of Alcohol Engines.

About the year 1876 there was placed on the American market the first successful internal-combustion engine using petroleum distillate. This engine was invented by George Brayton. Following the attempt of Brayton to use petroleum distillate came a series of inventions improving this class of engine, lasting for about twenty years, when the modern forms of kerosene, gasoline, and crude-oil engines may be said to have been developed. During this time the subject of alcohol as fuel in engines seems to have been either not thought of at all or not given any attention. The first serious attempt to examine into the possibility of alcohol as a fuel in competition with petroleum and its distillates seems to have been made in the year 1894 in Leipzig, Germany, by Professor Hartman for the Deutschen Landwirtschafts-Gesellschaft. The engine used was built by Grobb, of Leipzig, to operate on kerosene, and used 425 grams of kerosene per hour per brake horsepower, which is equivalent to 0.935 pound, or 1.1 pints, approximately. This indicates for the kerosene a thermal efficiency of 13.6 per cent. When operating on alcohol the engine used about twice as much, or 839 grams, which with this kind of alcohol was equivalent to a thermal efficiency of 12.2 per cent, or a little less than with kerosene. This experiment would seem to indicate that, compared with kerosene, alcohol, as a fuel, offered very little chance for successful competition. In spite of this, however, very vigorous efforts were made to develop an alcohol engine that would be better than this one, and thus was inaugurated a remarkable series of experiments, congresses, and exhibitions with the one end in view—of stimulating the production of the best possible alcohol motor.

The first stimulus was given by the German alcohol distillers, who sought to enlarge their market. They succeeded in interesting the German Government in the question by enlarging on the national significance of having available a source of fuel for power, inexhaustible in quantity, to be produced within the national domain from the yearly crops. Under the double stimulus of government assistance and the desire of the distillers to increase their output, inventors and manufacturers were induced to spend their time and money with a resulting decided improvement in the motor. An engine built by Kortink Brothers, of Hanover, fitted with a vaporizer invented by Petreano, tested at the Polytechnic School at Charlottenburg by Professor Slaby, showed a consumption of 550 grams of 86.2 per cent alcohol by weight, which is equivalent to 1.21 pounds, or 1.4 pints, or a thermal efficiency of 17.5 per cent. This result showed an advance of nearly 50 per cent in thermal efficiency over the Grobb engine tested a year or so earlier by Professor Hartman. Following this improvement there resulted a continual development of the alcohol motor, interest in which was kept up by exhibitions in which prizes were offered and by scientific societies.

Besides the above named, there were many others of lesser importance, all contributing to the rapid development of this class of machine.

The results of this development may be summed up by saying that the thermal efficiency of the motor was raised to something over 30 per cent, which is quite a remarkable showing in comparison with the original figure of 12.2 per cent in 1894. It must be clearly understood, however, in interpreting these figures that they are the best possible attainable at the time reported. They indicate, so far as the fuel costs are concerned, that with a motor specially constructed for alcohol the fuel prices per gallon might be twice as much for alcohol as for petroleum distillate and still give power for less money, assuming that attendance, repairs, lubrication, etc., cost no more in the case of the alcohol engine.

The Office of Experiment Stations of this Department, in connection with its Irrigation and Drainage Investigations, has tested a number of different types of gasoline engines with alcohol and obtained figures which show the comparative consumption of gasoline and alcohol in the same engine. The detailed results of these tests will be published in a technical bulletin, but the general results may be given here. The first tests were made without any particular attempt at obtaining the best adjustment of the engine for each fuel, and showed a consumption of alcohol two to three times as great by weight per horsepower hour as was necessary with gasoline or kerosene. These figures indicate the necessity or desirability of determining the proper conditions of adjustment, because these were found to have a serious influence on the amount of fuel consumed. With care in adjusting the engine so as to secure the most economical use of the alcohol, it was found that, under like conditions, a small engine consumed 1.23 pounds of alcohol to 0.69 pound of gasoline per brake horsepower hour—that is to say, with the best adjustment of the engine for each fuel there was required 1.8 times as much alcohol by weight as gasoline per brake horsepower hour. It was also shown in making this adjustment that it was possible to burn more than twice as much alcohol as stated, by improper adjustments, and still have the engine working in an apparently satisfactory way. The range of excess gasoline which might be burned without interfering seriously with the working of the engine was not so great, being a little less than twice as much as the minimum. These early experiments, therefore, confirmed the early results secured in Germany, to-wit, that an engine built for gasoline or kerosene will, when unchanged, require about twice as much alcohol by weight for the same work; but they also indicate something that is not pointed out by the reports sent us from abroad—that is, the great importance of securing the best adjustment of the machine.

ADVANTAGES OF CRUDE OIL.

Of the crude oil which is raised—some $20,000,000 tons per annum—about one-fifth is used for heating purposes. For these purposes, crude oil presents, as compared with coal, the advantages of greater heating value, smaller storage room, less labor, easy transport, regularity of action, smokelessness and absence of sulphur and corrosion of boilers; but in some countries the cost of it outweighs these advantages. In Russia, Austria, and Pennsylvania it is largely used for locomotives. Herr F. Heintzenberg gives the following as the heating values per pound, in pound-centigrade units: Recent coal, 6,500; older coal, 7,500; Paris gas tar, 8,900; shale oil, 9,000; American petroleum, 9,770; Pennsylvanian light naphtha, 9,960; Pennsylvanian heavy naphtha, 10,670; Baku light naphtha, 11,460; Baku heavy naphtha, 10,800; Belachany naphtha, 11,700.

A UNIQUE GAS MANTLE.

M. Emile Louis Andre has put forth a curious idea, and, what is more, he has patented it in France. He uses an egg-shell, literally an egg-shell, as an incandescent mantle, for acetylene flames. It does not shatter or break, he says. and it gives a pleasant soft light. All the preparation that is needful is to make a hole at each end of the shell, and to put the shell in position with the burner inside. The burner head throws out lateral flames which impinge on the interior of the egg-shell.

UNDERGROUND TRANSMISSION AND DISTRIBUTION OF ELECTRICAL ENERGY.

By Charles E. Phelps.*

The faults in underground cables naturally classify themselves as follows:

1. Defects in the cable itself.
2. Injury received during installation.
3. Faulty workmanship.
4. Mechanical injury.
5. Electrolytic action.
6. Certain external injuries, the cause of which may not be conclusively established.

And to these six may be added the injuries which occur to cables not strictly underground, but which are above the surface of the ground on poles, etc., making connection with aerial conductors. This latter is uniformly the result of imperfect covering protection, or results from contact with the cable sheath of aerial wires; they can hardly be classed with the faults of underground cables.

Referring to the other six classes of faults, the first three, viz:

1. Defects in the cable itself,
2. Injury received during installation,
3. Faulty workmanship,

should be sufficiently provided against in the contract for the cable and in the character of conduit construction, that they may be developed on the break-down test which is invariably applied to a completed cable before putting it into continuous service. This test usually requires that at least double the ordinary working voltage shall be applied to the insulation of the cable; that is, between conductors and ground, for various periods of time, depending upon the judgment of the purchaser and acquiescence of the contractor. The test should never be pushed to a point where the insulation is liable to be pin-holed by the strain of the test voltage, and experience has generally pointed to the continuance of the test voltage for from one to two minutes' duration, instead of thirty or more minutes which have often been specified. Under this test the defect should be developed and the obligation should, by contract, be imposed upon the contractor to make it good. If it should have been caused by any defect in the conduit construction the cable contractor would, of course, be blameless. The other faults:

4. Mechanical injury,
5. Electrolytic action,
6. Damage to cable above ground.

All these are of purely external cause.

In order to illustrate this feature more prominently, below is given a tabulated record of the cable faults in this city for the seven years ending December 31, 1906, together with the lengths of cable in use in each year. This tabulation includes all classes of cables:

13,000 = volt, alternating-current, three-conductor cable.
6,600 = " " " " " "
2,300 = " " " " " "
1,000 = " " " two- " "
500 = " street railway feeders,
250 = " three-wire distribution,

Telephone cables from 5 to 400 pairs,

Telegraph " " 20 to 200 wire,

and various smaller cables used for burglar and fire alarm and other signalling purposes, including the police and fire alarm wires of the city. In fact, the table includes injuries to all those classes of wires which are found to be necessary in the activities of any large and growing city. Summarized by classes of faults and by years, the table is as follows:

*Abstract from an address given before the American Institute of Electrical Engineers.

Cl'ss	Nature of damage	1900	1901	1902	1903	1904	1905	1906	Total
1	Defective Cable	—	1	—	—	—	2	—	3
2-3	Damage during installation	—	—	—	3	7	4	10	24
4	Damage by picks, bars, etc.	—	2	6	6	13	27	4	58
4	Flood water, Jones Falls......	—	—	—	1	—	1	—	2
4	Gas explosions	1	—	—	—	1	—	—	2
4	Rats	—	—	—	—	—	—	5	5
4	By workmen in manholes......	—	—	—	2	3	4	4	13
5	Electrolytic	1	—	2	15	5	4	4	31
6	Cables above ground...	—	1	1	—	—	—	—	2
7	Unknown........	—	—	—	—	—	7	1	8
	Totals......	2	4	9	27	29	49	28	148
Feet of cable in operation at end of each year........................		106,779	236,266	470,154	708,152	853,948	1,246,443	1,535,294	
Fault per 1000 ft. of cable		0,018	0.017	0.019	0.038	0.034	0.039	0.018	

It should be noted in connection with the table above given that damage under head of gas explosions was not the immediate result of the explosion, but was caused by the falling of debris and burning gas. No cable has been directly injured from any gas explosion under observation. Also, that the damage under "Flood Water—Jones' Falls" was due to the carrying away of cables on temporary suspension under a bridge crossing Jones' Falls, by heavy timbers carried down by flood water.

Summary of Cable Faults.

Class	Nature	Number of faults	Per Cent of whole
1.	Defective cable	3	2
2.	Damaged in installation.......	24	16
3.	Mechanical injury	80	55
4.	Electrolytic action	31	20
5.	Cables above ground	2	1.5
6.	Unknown causes	8	5.5
		148	100

The percentage in importance of each class of fault to the whole number is:

1. Defective cables .... 2 per cent.
2. Damaged in installation ....16 "
3. Mechanical injury ....55 "
4. Electrolytic action ....20 "
5. Cables above ground .... 1.5 "
6. Unknown . . .. 5.5 "

This is for the whole period of seven years; the record of the year 1906, just past, during which time there were over 1,500,000 feet of cable in operation, is as follows:

1. Defective cables ....none
2. Damaged in installation 10
3. Mechanical injury 13
4. Electrolytic action 4
5. Cables above ground ....none
6. Unknown 1

a total of 28 or $\frac{18}{1000}$ per 1,000 feet of cable in operation.

In considering the tabulations of cable faults, these data must be understood to show actual existing and not sporadic conditions; that not only do they cover a considerable period of time, but they cover, also, a time during which progress in this particular branch of the art was undergoing great changes. A part of the time may even be taken as experimental. In addition to this, the data for the years 1904 and

1905, shown in these tables, will suffer in its application to a normal situation by reason of the apparently high percentage of faults developed on account of mechanical injury.

Out of a total of 80 faults by mechanical injury for seven years, exactly one-half, or 40 of them, occurred during the years 1904 and 1905, although in 1906 there were but four, while the amount of cable in use was much greater.

This disproportion is easily explained by pointing out that during 1904 and 1905 all street improvements consequent upon the fire of February, 1904, were carried out. Street lines and grades were changed, necessitating a similar change in conduits and of cables within them. A great many men were employed upon all sorts of work, and, naturally, the underground system has to stand its share of damage.

In studying the list of cable faults you will see that, barring the sole element of human frailty, all the faults may be to a large extent anticipated, and in a large measure avoided. By analyzing these failures, you will find some definite reason for each of them to which a remedy can be applied. I do not intend to convey the impression that a cable system can be developed which will never be fault-proof, because the conditions under which it is operated are not those of a parlor game; but one has to deal with men and materials that are by no means perfect.

I can perhaps illustrate the conclusion which I desire to convey to you. Suppose, say, twenty important companies on this continent engaged in the same character of electrical business were to keep accurate records of the performance of their underground equipment under actual operation, with clear explanation of the conditions surrounding and the effect of each cable fault, and suppose that all these twenty separate sets of data were available to each one of the companies concerned, so that each would have, in addition to its own data, those concerning the cable performance of nineteen other companies. Suppose, now, you had these data in hand, what would be the result? You would eagerly search out those of the companies which showed few faults where you were subjected to many of the same kind, and you would get in touch with them and learn in what particular they had succeeded where you had failed. In the same way you would be called upon to explain your successful methods to certain others who had failed where you had succeeded. This is a process which seems so easy, so simple, and so inexpensive when the great benefits that would accrue are considered, that it seems surprising it is not an almost universal custom. I cannot refrain from backing up this statement by saying that this spirit of co-operation and co-ordination is one of the important elements which has maintained the pre-eminence of the Bell Telephone Company in its particular field of operation, judging solely by results from the point of view of an outside but interested observer.

Before closing this paper I ask your consideration to a brief review of this particular subject, which may really be termed the crux of the whole situation. Taking the cable faults in the order they appear on the chart, the first three:

1. Defect in cable itself,
2. Damage during installation,
3. Faulty workmanship,

should be covered by the contract for purchase and installation of cable, and they should be "smoked out" by the installation test before described. Owing to the fact that the factory test of cable before shipment is much more severe than the installation test, and that the factory test is made on the cable while submerged in water, it is more than probable that any fault developed in the body of the cable itself will be caused either during shipment or during installation.

It will generally be impossible to determine on light and power cables, which was the real cause, for the effect of the break-down is to destroy the evidence entirely; the affected part of the cable will vanish to parts unknown.

Faults due to installation are, in general, due to four causes:

1. Defective conduit structure,
2. Reckless or improper methods of pulling cable into ducts,
3. Rough handling or too sharp bends in manholes,
4. Badly made joints.

I think it sufficient simply to enumerate these causes to indicate the prevention or remedy.

Faulty workmanship may occur either during installation or later, due to additional taps or connections being made to an existing cable. Here the remedy, aside from the employment of only skilled and careful workmen, is to provide a manhole suitable for the conditions under which this work is to be done. There should be plenty of elbow-room, and cleanliness is one of the best friends to the underground cable. Even in a city without sewers, the expense of consistent drainage of manholes by expensive methods is justified.

Mechanical injury may come from without through the agency of the energetic man with the pick who generally never works so hard as when he is hacking away at something he has no business to hack; or it may come by reason of improper use of the manhole by workmen; or from such an unusual source as the despised rat, which has been dignified by what I hope are five obituary notices in our exhibited list, under the year of 1906.

I hardly feel able to point out any remedies against this prolific cause of cable trouble that have not already, perhaps, occurred to you, but there is one which comes from within and which often and unnecessarily results in trouble and is easily avoided. This, as is usually the case with internal cable troubles, concerns the manholes. I have myself recently seen inside the manholes of an important underground system where the cables therein were so run through the manholes that it is impossible for a workman to get to the floor of the holes without using these cables as a step ladder. This was the case, not in a single manhole, but in many of them. Apparently the manholes were built simply because every other underground system had them, and they exhibited utter disregard of their permanent use by the cable equipment for which they were built.

LIGHTNING EFFECTS ON TELEPHONE POLES.

In the "National Telephone Journal" for February there are some interesting particulars of the effects of lighning upon the outside equipment of the National Telephone Company, which were observed in Nottingham last summer. The following is a noteworthy occurrence: During a heavy thunderstorm last summer one of the company's poles, just erected, but carrying no wires, was struck by lightning. The earth wire, with the exception of about 8-inch coiled round the pole near the top, had completely disappeared, and no trace of the staples which originally held the wire could be found. At the point where the staples had been fixed the pole was punctured as if by climbers, but the holes were bigger than those ordinarily made by climbers. A hole 2 feet deep was made in the ground where the earth wire entered. The hedge on the roadside, which was close to the pole, was badly scorched. The nails holding the roof on the pole were withdrawn to about half their length, but the roof was not damaged. The pole itself did not appear to be damaged otherwise than by the apparently sudden fusing of the staples. Three holes about 1 foot deep and 1 foot in diameter were made in the ground on the opposite side of the ordinary roadway of the pole. Another incident occurred during the building of the same route. About two miles of wire had been erected on the poles, and left "dead" on the insulators at one end. At the other end the wires came down from the pole in coils, which were hung on a wooden fence. When the men went to pick up the coils to proceed with the works, they received shocks similar to those from a Leyden jar discharge. The weather was cloudy and thundery, although no storm was taking place at the time.

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EASTERN AGENCIES

NEW YORK ....
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Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," with which is incorporated "The Engineers', Architects' and Builders' News."
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Entered as "The Electrical Journal," July, 1895.
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Vol. XVIII MARCH 23, 1907 No. 12

EDITORIAL.

Modern Elecrrical Generators and Converter Systems

The high-tension committee of the American Institute of Electrical Engineers is responsible for two short articles to serve as introductions to the discussion of these papers, to be held at a special meeting of the Institute, in New York, on March 22nd. "Motor-Generators vs. Synchronous Converters," with special reference to operation on long-distance transmission lines, is treated by Mr. P. M. Lincoln. The other paper, entitled "The Practicability of Large Generators Wound for 22,000 Volts," is by B. A. Behrend. Both of these subjects are of considerable interest to the electrical engineers of the West.

Mr. Lincoln, in his treatment of the subject of the transformation or conversion of electrical energy from alternating to direct current, states that the problem is practically that direct current of approximately constant voltage, either for electrical railways from 500 to 700 volts, or for incandescent lighting systems from 100 to 275 volts, or for electrolytic processes at any voltage, covers the requirements as far as the utilization of the electrical energy, while the source of power is necessarily alternating current at from twenty-five to sixty cycles, the voltage at the point of delivery being subject to considerable variation.

In comparing the motor-generator with the synchronous converter, the points considered are given as follows in the order of their relative importance from the author's standpoint:

1. Reliability.
2. Voltage regulation.
3. Corrective effect.
4. Efficiency.
5. Cost.
6. Parallel operation.
7. Starting.

Without going into the details of the facts and arguments presented by Mr. Lincoln, he concludes that for reliability, efficiency and less first cost, the synchronous converter has distinct advantages; that for parallel operation, the two systems are practically on an equal basis and that for voltage regulation, corrective effect and convenience and ease of starting, the motor-generator has the advantage. Further, it is the author's conclusion that there are probably but few cases where the motor-generator should be used preferably to the synchronous converter.

It is questionable whether Mr. Lincoln's conclusions will receive the unqualified endorsement of the engineers identified with the installation and operation of the long-distance transmission lines of the Pacific Coast. This is probably in a large part due to the fact that a frequency of sixty cycles has been adhered to almost entirely in the large central California plants, while fifty cycles is to be found in practically all of the transmission systems of Southern California. It is also to be remembered that direct current for railways is not now limited to between 500 and 700 volts. In the near future it is very probable that for the interurban street railway systems 1,200 volts will be substituted on long direct-current lines. With the comparatively high frequency of sixty cycles and 1,200 volts direct current required, it would seem from the experience of engineers in long transmission lines that the motor-generator should give much better all-round service than the synchronous converter.

It will probably be found that the placing of reliability first in the requirements of energy conversion will appeal most strongly to operating engineers. Where a number of generating plants are connected to a network of transmission lines, and particularly during the winter season, interruption of service, or, at times, great fluctuations in voltage are not uncommon. For voltage regulation and reliability of operation, certainly the motor-generator set has a great advantage over the synchronous converter.

By "corrective effect" is meant the voltage regulation of the transmission line by means of the change in the power factor of the current taken. This matter is of great importance, as the length and voltage of the transmission lines are increased. Ordinarily an induction motor would provide sufficient inductive current to offset the charging current in the line. However, the power factor of the induction motor is not subject to regulation or adjustment, while with the synchronous motor or synchronous converter, the range of adjustment of the power factor is consider-

able, and both can be operated with either leading or lagging current in a varying degree.

The reliability of operation, possibility of voltage regulation and the corrective effect, taken together, are certainly of much more importance than the combination of high efficiency, less first cost, ease of parallel operation and normal conditions during the starting of the machines.

Mr. Behrend's paper is of interest as showing the tendency in the construction of large units. The four types of prime movers considered by him are as follows:

1. Hydraulic Turbines.
2. Gas Engines.
3. Reciprocating Steam Engine.
4. Steam Turbines.

The author considers that generators exceeding 7,500-kilowatt capacity, operated by hydraulic power, will be comparatively few, and that the same thing may be said in connection with the gas engine. Also that the reciprocating steam engine is not as well adapted to very large units, namely, 7,500-kilowatt or larger, as is the steam turbine, the reason being that with the steam turbine comparatively high speeds are possible.

With large units, from 7,500-kilowatt to, possibly, even 25,000-kilowatt, there can be no reason why the voltage of the machine should not be from 20,000 to 25,000 volts. The matter of insulation of the conductors of the armature is simply mechanical, and as the size of the generator is increased without increasing the armature current, the insulation of the armature conductors becomes relatively less difficult.

From the standpoint of the operating engineer, there can be no question of the advisability of increasing as greatly as possible the generator voltage. Step-up transformers not only increase the first cost of the building and equipment, but introduce difficulties, particularly where burn-outs are liable from lightning or other electrostatic disturbances. If the long-distance transmission systems on the Pacific Coast were to be built to-day, in the light of the experience which is now available, units of from 5,000 to 10,000 kilowatts would be installed in place of the many small machines that are now in operation. All of the generators would be of the rotating-field type, and many would have an initial voltage of from 6,000 to 25,000 volts.

TRADE CATALOGUES.

A SCHOOL OF RAILWAY ENGINEERING AND ADMINISTRATION.

The University of Illinois, recognizing the important commercial position that the railroads of this country fill, and the complexity of organization imposed upon all those engaged in their service, has established in the College of Engineering a new Department of Railway Engineering. Under its direction the following four courses are offered:

1. Course in Railway Civil Engineering.
2. Course in Railway Electrical Engineering.
3. Course in Railway Mechanical Engineering.
4. Course in Railway Administration.

It is planned that these courses will prepare men to perform more efficiently, through the special training obtained, the duties connected with the motive power, maintenance of way, financial, traffic and operating departments of railway service.

ANNOUNCEMENT.

The Thomas S. Clark Son Memorial School of Technology has sent out invitations for the eleventh anniversary of the granting of the charter by the University of the State of New York.

Commemorative exercises will be held on the eve of Charter Day, March Eighteenth, Nineteen Hundred and Seven. The address will be delivered by Frederick Remsin Hutton, E. M., Ph. D., Sc. D., Professor Mechanical Engineering, Columbia University and President American Society of Mechanical Engineering.

PERSONAL.

Mr. J. F. W. Bunsen has entered the employ of Muralt & Co., Engineers and Contractors, New York, and will take charge of their Southern office in Charleston, S. C.

Mr. Bunsen, who is a nephew of the late Prof. Bunsen, the inventor of the burner which bears his name, has had many years experience in designing and erecting important engineering works. At the time of the Galveston flood Mr. Bunsen was engaged as the Mechanical Superintendent of the American Cotton Co., Southern District. He was delegated by the City of Galveston to prepare the designs and plans for a system of break waters and although his plans were not immediately utilized on account of lack of funds, the present admirable break water system has been built practically in accordance with his original ideas and plans. His experience also includes the design and erection of various breweries, sugar refineries, spinning mills and electric light and power plants, including oil refineries for the Standard Oil Co. in Mexico and South America, cotton mills for the American Cotton Co. and various sugar plants in Cuba, Mexico and South America.

Mr. Bunsen will have charge of Muralt & Co.'s various projects in the Southern States, and especially the large power plant which that Company is now building for the U. S. Government at the Charleston Navy Yard.

LUMINESCENCE OF THE GAS MANTLE.

Dr. C. Killing finds that a Welsbach mantle gives, in a flame of hydrogen burning in chlorine, a blinding greenish light. The mantle was not attacked by the chlorine. Dr. Killing concludes from this that the ceria in the mantle does not act as an oxygen carrier, and that the luminescence is an effect of high temperature simply.

Long Beach, Cal.—Work on the extension of the Pacific Electric main line to West Long Beach is being pushed rapidly.

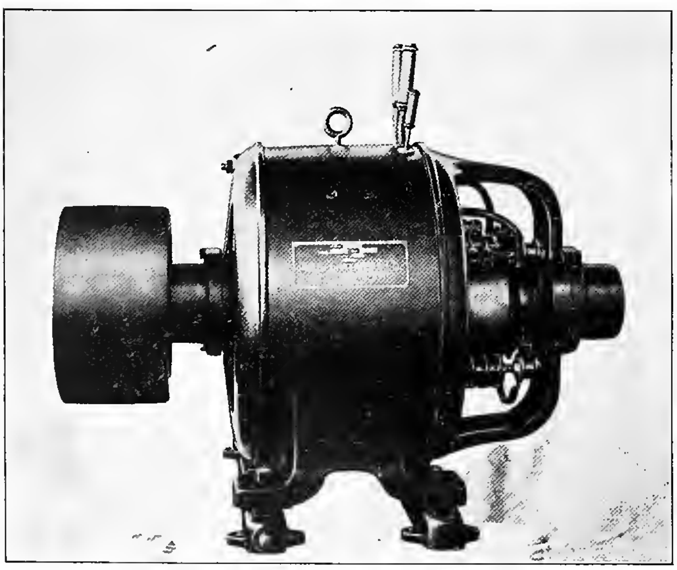
INDUSTRIAL

ALLIS-CHALMERS DIRECT CURRENT MOTORS AND GENERATORS—TYPE "K."

The growing demand for direct current electric motors that can be applied to the individual drive af machinery of various kinds has led to a number of important changes in both the mechanical and electrical design of the motors heretofore used. To meet the requirements of this service the construction should not only be compact but also permit of mounting the motor in any position; while the windings and commutator must be either partially or wholly protected from external injury. Geared and direct-coupled methods of driving are rapidly displacing belts, and this, together with the fact that sudden and excessive overloads are of common occurrence, requires larger bearings and shafts of greater stiffness than were formerly used in motors of the same class. The demand for a wide variation in speed by shunt field control, with occasional heavy overloads at any speed, has also called for material improvement in commutating qualities.

Allis-Chalmers Company, of Milwaukee, announces a new line of direct-current motors, designated as Type "K," which have been especially designed to meet these mechanical and electrical requirements. They are equally well adapted to belt drive at constant speed and continuous service, or geared drive, variable speed and intermittent service.

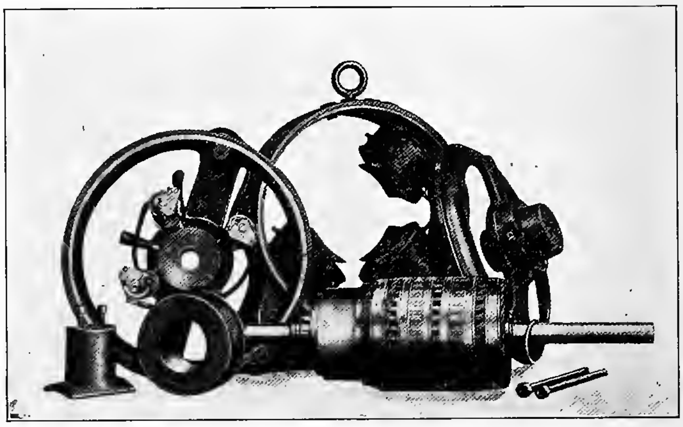
Their external appearance is similar to the well-known Types "N" and "B" motors heretofore manufactured by that company, but the construction differs in many important details and, in fact, represents a new design throughout. The changes, both mechanical and electrical, are the result of many years' experience in the construction of motors for industrial purposes. The machine is very compact, the construction is rigid, and every detail has been worked out with



ALLIS-CHALMERS TYPE "K" MOTOR.

especial reference to the most exacting requirements of modern service.

The cylindrical field magnet yoke is of open hearth steel and machined on each end to receive the housings that carry the bearings. The housings are held in place by through bolts and, on four-pole machines, can be rotated 90 degrees or 180 degrees to allow side-wall or ceiling mounting; bi-polar machines can be arranged for floor or ceiling mounting. The yoke is machined on the inside cylindrical surface and the poles are fastened to it by counter-sunk fillister-head cap screws. The pole cores are of open hearth steel and are circular in cross section; these cores are machined on one end to fit the inner surface of the cylindrical yoke and on the other to receive the pole shoes. The latter are built up of annealed steel punchings riveted together and fastened to the poles by flat head machine screws. The pole face has been carefully shaped to give suitable distribution of the



5-HORSEPOWER ALLIS-CHALMERS TYPE "K" MOTOR, DISMANTLED.

field flux, thus securing good commutation and preventing humming due to the armature teeth. The field cores are wound on metal spools, except for the smaller sizes, and are covered with sufficient insulation coated with varnish to protect them from external injury or moisture.

The armature cores are built up of sheet steel punchings insulated from each other to reduce the core loss and consequent heating. The laminations are keyed to the shaft, and in building up the core they are separated at intervals so as to form radial ventilating ducts. The punchings are firmly clamped between cast iron end heads, which also serve as supports for the ends of the armature coils. In punching the armature laminations, openings are made in the discs, so that when the latter are assembled, ventilating passages are formed parallel to the shaft and connecting with the radial ducts. There is thus a free passage for circulation of air through the core, and all parts of the core and windings are thoroughly ventilated.

The armature coils are form wound and interchangeable; they are heavily insulated with stay binding and the whole armature is thoroughly impregnated with insulating varnish after it has been completely wound.

The commutator is of large diameter and ample wearing depth, having bars of hard drawn copper insulated from each other and from the shell by the best quality of mica; the mica between bars is selected so as to give even wear. The clamping rings hold the bars very firmly, and the whole construction is such as to secure a perfect cylindrical surface free from high or low bars.

The commutator sleeve, in all except the smaller sizes, is cored to permit the passage of air through to the armature.

The shaft is made of high carbon steel, which is very stiff and can stand heavy overloads without vibration or bending.

The bearings are amply large, and lubricated by oil rings which rest on the shaft and dip into oil wells beneath. The shaft projection for the pulley is turned smaller than the journals, so that the journal can be turned down, when worn, without reducing its diameter below that of the projection.

The brush holders are of the reaction type, of the same

general design as used on all Allis-Chalmers standard direct current machines. They are simple in construction, positive in action, and allow the brush to follow the surface of the commutator freely. The brushes are held firmly to the holders and, while they can be readily removed, for inspection, it is not possible for them to get out of place while in service. The brush studs are fastened to a rocker arm mounted on the bearing housing; this allows the brushes to be set at the best running position, but, after being once properly set they require no adjustment under any change in load within the range of the motor. The brushes are graphite and are connected to the holders by flexible copper shunts so that current is not compelled to pass through any sliding contacts; ample carrying capacity is provided in the brushes and brush holders and all parts operate at low temperature.

The standard Type "K" motor is made open at the ends to permit a free circulation of air through the machine; it can, however, be made semi-enclosed or totally enclosed by the addition of suitable metal enclosing covers which are readily fitted to the end housings. For the semi-enclosed type the covers are perforated, forming a screen cover which, while allowing a circulation of air, protects the motor from flying particles; this type of motor can be used on work where an open motor would not answer but where an entirely enclosed one is unnecessary. Totally enclosed motors are dust and moisture proof, since the tightly fitting covers close up all openings. This shuts off the ventilation, and the output of a given frame for the totally enclosed type is less than for either the semi-enclosed or the open types.

In the use of variable speed motors for the individual drive of machine tools, there are two points to be carefully considered:

(1) The size and weight of the motor is dependent to a great extent on the minimum speed at which the motor is required to develop its full rated power; the slower the minimum speed the greater will be the size and weight for a given horsepower output.

(2) The maximum speed of the motor is dependent on the peripheral speed of the armature, commutator, pinion, or belt; or upon the ratio of speed reduction between the driven shaft and the motor shaft. This limits the maximum speed to 1,000 to 1,600 revolutions per minute, depending on the output of the motor. The maximum speed being thus fixed by mechanical limitations, any increase in the range of speed variation must be obtained by decreasing the minimum speed and consequently increasing the size of motor for a given output, or decreasing the output for a given size. These mechanical limitations make it desirable to keep the speed range down to a reasonable amount and it has, therefore, in Type "K" motors been limited to a ratio of 1:3.

These motors are manufactured in 13 different frame sizes, and for each size there are a number of ratings, the output of a given frame being proportional to the speed.

Type "K" motors are suitable for all classes of work where either a constant or variable speed direct current motor is required. For general driving of machinery or for variable speed work shunt wound machines are used. For cases where a large starting torque combined with the constant speed characteristic of the shunt motor is required, compound wound motors can be furnished. For crane and hoisting service series wound motors are supplied.

Type "K" machines operate exceptionally well as generators which are compound wound, and will deliver any current from zero to their full rated output without sparking and without shifting the brushes.

Type "K" machines are given the same high grade finish that characterizes all Allis-Chalmers electrical apparatus. All castings are filled and rubbed down to a smooth surface. The workmanship is first class throughout and all motors are thoroughly tested before being shipped.

Lewiston, Ida.—The Northwestern Railway has begun work on a line between here and Huntington.

MODERN SWITCHBOARD DEVICES.*

C. W. Stone.

The oil switches of today are very necessary in high-tension systems for the distribution of energy, and to them is to be attributed the successful operation of such systems. The opening of an arc in the air on an alternating-current system is apt to result in dangerous rises in voltage, by causing surges in the system. Indications tend to show that an oil switch opens on the low point of the wave, or practically at zero current, and for this reason it has a tremendous advantage over any switch opening in the air.

A switch, which may be considered as an example of present oil switches for moderate capacities, has the operating mechanism and the contacts and the contact rods, etc., located on a top casting. The contact rods which pass through the casting are surrounded by porcelain insulators. These contacts are enclosed in an outside tank, which is filled with oil, barriers being placed between the different poles. Contact yokes are carried on the end of wooden rods, which are attached to the operating mechanism. The movement of the handle raises or lowers the yokes, bringing them when raised into connection with the contact blocks.

For very large loads a totally different design of switch is used. Each pole of this switch is made up of two cylindrical oil vessels, the bottom of which contains a contact. The oil vessels are mounted on large insulators placed in the base of a switch compartment. The two elements of each phase are separated from the other phases by means of brick or soapstone barriers. Passing through the top of the two oil vessels of each phase are two contact rods which are placed on a yoke. The yoke is fastened to the operating mechanism by means of a long wooden rod. The connections to and from the switch are made to studs passing through the insulators which support the oil vessels. The operation of this switch is exactly opposite to the one described above, as in this case the contact rods are pulled up from the contacts, while in the other type of switch the contact rods are dropped away from the contacts. The operating mechanism may be driven by compressed air or electricity. With the electrically-operated switch, the tripping is entirely independent of the motor, as the action of the switch is such that the motor carries the crank of the mechanism slightly past the center, where it is held in position by a small toggle which is opened by means of a small electro-magnet. Many improvements have been made in the small details of this type of switch since it has been in use. One of the latest and best improvements is in making the oil vessels of pressed steel. The original vessel was made of seamless brass pipe. In the lower end of this pipe a bottom carrying the contact was soldered, and the top was threaded to receive the cap. The new type of vessel is made of steel, the top being put on in the same way as on the brass pipe.

Oil switches of the type just described are in successful use for e.m.f.s as high as 60,000 volts. In the 60,000-volt switches, the oil pots instead of being of metal are made of wooden staves somewhat like a barrel, held together by wrappings of cord. The pots are mounted on insulating standards.

For alternating-current work a number of different types of relays are in use; the overload relay which has been generally used consisting of a simple solenoid and a set of contacts, so arranged that the movement of the plunger in the solenoid will properly operate certain contact mechanisms. The relays are made both for instantaneous operation and with time-limit arrangements. An excellent type of time-limit arrangement consists of a simple bellows placed above the contacts and fastened to the plunger. This bellows is provided with a small valve at the top, the open-

*Abstract of paper read before the New York Electrical Society.

ing of which can be adjusted so that the relay can be set for any desired time. With a relay of this type the time element is dependent upon the amount of current flowing through the solenoid, and is practically directly proportional to this current. Thus, if set for a certain time with a certain current, if the current is double, the relay will open in practically half the time, and in cases of short-circuit, it becomes practically instantaneous.

Another type of time-limit relay is the definite type which is made in two ways. One is the bellows type, which is very similar to the inverse time element type, the only difference being that the plunger is not rigidly connected to the bellows, but has a spring interposed in such a manner as to make the pressure on the bellows constant whenever the relay operates. The other form is a clock-work mechanism, which revolves a fan, the blades of which can be adjusted so as to require a pre-determined time of operation.

SINGLE-PHASE GENERATOR AT BELLEVILLE, ILL., WORKS ECONOMY IN FEED WIRE COPPER.

Belleville, Ill., having some 20,000 inhabitants, possesses a greater number of manufacturing industries of various kinds, especially foundries, than is usual for a town of its population. The Belleville Gas & Electric Company, which has been supplying both light and power for these factories for several years, for a long time maintained a 500-volt, direct-current service which, it was found, required considerable expenditure for feed wire copper in order to extend and enlarge its service to take care of new factories scatterd along the rights-of-way of several railroads passing through Belleville.

A means of overcoming this difficulty was presented in the alternative of supplying power from single-phase lighting circuits or of installing a polyphase distributing system for power purposes. The latter plan involved expensive changes, so that the use of a single-phase system was adopted and a Corliss engine direct connected to a single-phase generator was the equipment selected to solve the difficulty. The generator is a 550-kilowatt, 2,300-volt, 60-cycle machine of standard Allis-Chalmers design, and the engine is one of the well-known Reynolds Corliss type, 30-inch by 48-inch, also built by that company.

While a considerable portion of the present output is through a 500-volt, direct-current generator, the 500-volt system is not being extended. All new business is taken on the single-phase alternating-current circuits, and some business has even been changed from 500 volts direct-current to single-phase, alternating-current, because of better voltage regulation on the alternating-current circuits. Out of a connected load of about 900-horsepower, 500 is in direct-current motors.

THE ELECTRIC STORAGE BATTERY CO., GENERAL OFFICES PHILADELPHIA, PA.

Announces the removal, on April 22nd, 1907, of its Pacific Coast sales office from No. 525 Thirteenth Street, Oakland, to temporary quarters at No. 11 Hawthorne Street, San Francisco. Later, notice will appear of its removal into permanent quarters now being prepared in the Crocker Building.

The operating department will be permanently located, after April 1st, 1907, at No. 11 Hawthorne Street, San Francisco.

The Pacific Coast stock of "Exide" and "Chloride" batteries will be handled by, and may be purchased of the "Exide Battery Depots, Inc.," which will be permanently located at No. 11 Hawthorne Street after April 1st, 1907. R. B. Daggett, manager San Francisco office.

BAY SHORE ELECTRICAL CONSTRUCTION COMPANY REMOVED TO NEW QUARTERS.

We wish to announce that we have removed our shop to more spacious quarters at No. 40 Tehama Street, San Francisco, where we are equipped to handle all classes of electrical and machine repairs, and still have our armature and switchboard departments at the disposal of our friends.

ELECTRIC WIRING RULES IN TORONTO.

The leading electrical firms in Toronto have adopted a new code of rules bearing on electric wiring with a view to better standardization and reducing fire risks. These rules are embodied in a bulletin (No. 8) issued by the electrical department of the Canadian Fire Underwriters' Association, and are designed to meet not only modern requirements but to prepare for what seems inevitable in Toronto—namely, the increasing of the lighting voltage from what it is at present to 240-480-volt three-wire system. The committee state that in anticipation of this increase in voltage, they desire to see adopted "new code standard cut-outs equipped with approved enclosed fuses. This will mean, so far as the city of Toronto is concerned, the complete discarding of all other styles of fuses. In factory work and other places where drop lights are to be used, the use of fused rosettes is to be entirely abandoned. Generally speaking, the observance of the separation of wiring in concealed work will have to be more carefully regarded, and while we will not expect the full 10-inch between wires of opposite polarity, we will expect that the wiring in such places will be more spread than it is at present, and that the running of wires underneath bath-rooms, where they are liable to come in close proximity to water-pipes, be carefully avoided." The foregoing requirements are asked for immediately. The use of nails in connection with insulators is also to be discontinued, and the bulletin states that the committee expect that they will be securely fastened with screws. The use of ordinary weather-proof wire is prohibited, and for all inside work, slow-burning weather-proof wire is to be used, except in damp places, in which locations improved rubber-covered wire may be used. Aerial service wires in pipe or otherwise must not be concealed in walls or partitions before entering cut-out and switch. All branch circuits of two wires from center of distribution to lamps should consist of a black and a white core wire, being colors easily distinguished, the black wire being merely maintained as the neutral or grounding wire and the white for the positive, so that the mistake of placing the single-pole switch on the black wire may be avoided. In bath-rooms, cellars, or any place where it is liable to be damp, or where a person is liable to stand and touch wires, outlets should be on the ceiling. All electrical contractors should endeavor to keep the receptacles, sockets, and fixtures throughout an installation polarized, so that the black or neutral wire shall be always on the shell side of the socket or lamp. Parties installing electric fixtures are strongly advised to have them thoroughly inspected, and contractors are urged and requested to pay particular attention to the making and finishing of joints under canopies. Special rules have also been formed for other general electric work.

San Jose, Cal.—Within fifteen days the Santa Clara street line, from First Street out to the Alameda, will be in operation on one track, and in thirty days, it is estimated, both tracks will be ready for public service. The work, which commenced a few days ago, of broadening the gauge of the tracks has been going on rapidly, and an extra gang of workmen has been put to work to expedite matters. One of the finest road beds in the West is being prepared, and when the track is finally ready for the public it is expected by the company that the highest class of street railroading will be given.

NEWS NOTES

ELECTRIC RAILWAYS.

Lind, Wash.—R. Roberts has taken the contract for three and a half miles of the Milwaukee grade from the crossing of the N. P. east.

Bellingham, Wash.—It has been reported that the Bellingham Bay & British Columbia Railway has been acquired by the Northwestern Portland Cement Co.

New Westminster, B. C.—Construction work on the V. V. & E. between Cloverdale and Abbotsford will commence shortly.

Seattle, Wash.—The C., M. & St. P. Railway has filed an application for a permit to lay two and a half miles of track in the city at once.

North Yakima, Wash.—Actual construction on the mountain division and Yakima section of the C. M. & St. P. Railway from the Columbia River to Seattle will commence April 1st.

Elma, Wash.—The N. P. Railway Co. will begin work on surveying the probable new line of railway that is to encircle the Olympia Peninsula, at once.

Lakeview, Ore.—E. H. Harriman has bought the Corvallis & Eastern Ry., running from Yakima Bay to Idanha, a distance of 142 miles.

Bellingham, Wash.—It is reported that the N. P. Railway will build a brick and stone depot here, and also a mile more of sidetrack, making an expenditure of between $40,000 and $50,000.

Northwestern Gas and Electric Company—Isaac W. Anderson, president, and A. Welsh, manager, who have just completed a tour of inspection over the system, announced in Spokane that trains will be operated between Walla Walla and Freewater and Milton in less than sixty days

Spokane Northern Electric Railway Company—Francis D. Cook, one of the original projectors of the system to operate between Spokane and Dartford, announces the line will not be built this year. The land deeded to the company by Mr. Cook has been turned back to him, and the company will be reorganized.

Tekoa-Saint Maries River Railroad Company—These officers have been elected for the year: President, F. J. Mahoney; vice president, E. C. Dowel; secretary, M. D. O'Connell; treasurer, Dr. W. A. Mosier; also a directorate of fifteen members. The line will extend from Tekoa, Wash., south of Spokane, to Indian Creek, and will be in operation, it is given out, in time to move the season's crop. Electricity will be the motive power, and street cars will be operated in Tekoa. The line will be ultimately extended to the timber belts of the St. Maries River in Idaho.

Lewiston & Southeastern Railway Company—G. W. Thompson, a stockholder, announced in Spokane that the Schofield Company, of Philadelphia, will build the system, which, together with the power house on Salmon River, will cost $5,200,000. He added that construction work will begin the coming summer on the Lewiston and south of Spokane, continuing toward Waha and Grangeville. The work will require two years. It is given out that the bond issue covering the cost of the system has been disposed of to eastern investors.

Spokane & Inland Electric Railway System—Announcement is made that the company will build 200 miles of line south of Spokane during the coming year. The main line from Spokane to Colfax, 80 miles, and branch lines to Moscow and Lewiston are included in this. Projected lines run from near Colfax to Snake River to connect with the line from Walla Walla north through Dayton.

Okanogan Electric Railway—Reports from Riverside, Wash., are that the electric road, projected by A. M. Dewey, of Spokane, which was to be built from Nighthawk to Brewster, Wash., has changed its route, and is being surveyed from Nighthawk via Loomis, Fish Lake, Johnson Creek Valley, across the government's Okanogan irrigation project to the new town of Omak, on the Okanogan River, across the latter, through Omak Pass on the south half of the Colville Reserve to the mouth of the Spokane River, thence on to a terminus in Spokane. This leads to the expressed belief that the road is a branch of the Graves system. Mr. Dewey is in New York on business in connection with the project.

FINANCIAL.

Sacramento, Cal.—Gov. Gillett has approved the Willis bill legalizing certain municipal issues of bonds which will enable Los Angeles to issue $23,000,000 for a new water system. It is expected that action will be taken on the issue at once.

San Diego, Cal.—An election has been called in this city on March 12 to vote on an issue of bonds amounting to $884,533.71. The money is to be spent to construct and acquire a line of water pipe; for the enlargement and extension of the water system; for reservoirs, boulevards, reinforced concrete culverts; for construction of a building and repair of other buildings for the fire department; for a park, extension of sewer systems and for three public lavatories.

Fresno, Cal.—One day before the option was to have expired, the properties of the Oil City Petroleum and the Twenty-eight Oil Companies, in the Coalinga field, passed into the hands of parties represented by W. M. Hall, of San Francisco, for the sum of $855,000. But the hand behind the purchase is that of the Standard Oil Co. The transaction is the largest ever consummated in Fresno County. There are 280 acres in the lease of the Oil City, and 160 in the Twenty-eight. The combined wells are recognized to be among the best producers in the State. Outstanding moneys will be called in and the two companies will be liquidated. The transaction is not a shift in the control of stock, but a complete purchase. For some time the product of both companies has been sold under contract to the Standard Oil. But when the contracts expired no new ones were drawn up and operations at the wells were practically suspended. Under ordinary circumstances the twenty-five shafts produced each month about 50,000 barrels of high-grade oil. A short time ago the Standard Oil Co. purchased eight acres of oil lands belonging to the Oyama Oil Co. and the Forty Co. The purchase price was $350,000. This, added to the recent deal with the Twenty-eight and Oil City concerns, makes a total transaction of $1,205,000. Not long previously a $2,000,000 deal, to be paid in installments by the Standard, was brought to a head.

San Francisco, Cal.—An immediate seizure of the properties of the Spring Valley Water Co. has been advised by City Attorney Burke in a communication to the Board of

Supervisors. He and his assistant, Wm. S. Baggett, have fortified themselves with many legal authorities to support the proposed action of the city, and declare that the Supreme Court of California has so passed upon the issues involved that there can be no question of the right of the city to proceed at once to drastic action. Attorney Burke says: "No further legal action is necessary to enforce the forfeiture. It need not be established judicially. The forfeiture is declared by statute, and when so declared the title goes with it. The title immediately vests in the State upon the happening of the event or the commission of the offense for which the forfeit is declared. This is the settled law of the State." Attorney Kellogg of the company declares that the Federal Constitution would prevent the seizure of the water works, as article 14 states that private property shall not be taken for public use without just compensation. He says that the whole matter will have to be threshed out in court, as the supervisors will have to prove their accusation, and that until this is done their action in declaring the property of the company confiscated and forfeited has no legal force. Capt. A. H. Payson, the president of the corporation, says that the city will have to pay for the water works if it wants them, and sets the price at $50,000,000. He says: "We are quite willing to sell our plant, but we shall not submit to any act of piracy on the part of the supervisors or any other city officials." City Attorney Burke takes the ground that the plant of the Spring Valley Company is not private property, and that therefore the Federal Constitution does not apply to the case. Secretary Duke, of the company, states that he will cut off the supply outside of the town if the proposed action is taken, and the city will get nothing except a series of empty pipes.

OIL.

Los Angeles, Cal.—The Bowser Oil Tank Co. has written to the president of the Chamber of Commerce in regard to securing a site on the inner harbor.

Santa Monica, Cal.—The Santa Monica Oil and Gas Co. has been organized to drill a well about ten miles northeast of the town. Thaddeus Brewster has been made president of the new company. Several Los Angeles men are interested in the project.

San Luis Obispo.—In a letter to the "Pacific Mining and Oil Reporter," L. E. Blochman writes: "Along the water front, about six miles from the Tiber, Oil Port is looming up on San Luis Bay. The substantiality of the buildings can be seen by the manner in which the foundations are laid. The California Petroleum Refineries Co., Ltd., is doing the most far-reaching things possible, following generally the lines of the Union Oil Co., except that it is having its refinery plant connected by pipe line from the Graciosa property at Santa Maria. Both the Union and the Standard must transport their oil by ships to a distant refining point, a delay and an expense that the California Petroleum Refinery overcomes.

San Francisco, Cal.—In February the cargo shipments of refined petroleum to foreign countries from the local customs district were as follows:

To	Gallons.	Values.
Madras, India	2,394,000	$ 93,366
Hiogo, Japan	931,000	69,840
Shanghai	1,600,000	62,400
Total refined	4,925,000	$225,606
Crude Oil, Honolulu	630,000	9,000
Grand Total	5,555,000	$234,606

The cargo of refined for Hiogo was in cases, and the balance was in bulk. In January the shipments were very large, being 7,412,002 gallons, and all refined.
The Union already has found it very profitable to have a smaller refinery near Port Harford Wharf to take off the top oil for such fuel oil where the law exacts a high-flash test.

PRODUCTION OF OIL FOR 1906.

Estimates of United States production and consumption of oil for the past year, designated in barrels, are in round numbers as follows:

Fields.	Production.	Consumption.
California	26,000,000	32,000,000
Pennsylvania	25,000,000	27,000,000
Ohio and Indiana (Lima oil)	24,000,000	28,000,000
Kansas, Ind. Territory and Oklahoma	22,000,000	13,000,000
Texas and Louisiana	21,000,000	29,000,000
Illinois	3,000,000	1,500,000
Kentucky and Tennessee	1,200,000	1,000,000
Other States	1,000,000	1,000,000
Totals	123,200,000	132,500,000

For the purpose of comparison the government's report by States of production in 1905 is reproduced as follows, the designation being in barrels: California, 33,427,473; Texas, 28,136,189; Ohio, 16,346,660; Kansas, Indian Territory and Oklahoma, 12,013,495; West Virginia, 11,578,110; Indiana, 10,964,247; Pennsylvania, 10,437,195; Louisiana, 8,910,416; Kentucky and Tennessee, 1,217,337; New York, 1,117,582; Colorado. 376,238; Illinois, 181,084; Wyoming, 8,454; Missouri and Michigan, 3,100. This summary includes with Ohio's production, 5,016,736 barrels produced in Southeastern Ohio, which was of the Pennsylvania grade, and which, added to the New York, Pennsylvania and West Virginia production, made the production of crude of the Pennsylvania classification 28,149,623 barrels for the year 1905.

TRANSMISSION.

Stockton, Cal.—The American River Power Co. purchased recently from the Weber Home Co. lots 2, 4, 6, 8, 12 and 14 in block 23 west of Center Street, and located on Lindsay Street between Madison and Monroe Streets. The power company will establish a sub-station in Stockton to supply light and power and to act in all respects as an auxiliary to the main plant.

Los Angeles, Cal.—The city has advertised for bids for furnishing the necessary hydraulic and electrical machinery, apparatus and line material for equipping one hydro-electric generator plant of 125-kilowatt capacity, five miles of 15,000-volt transmission line, and step-up and step-down transformers. The apparatus must comply with plans and specifications now on file in the office of the Board of Public Works.

Anderson, Cal.—A large water-storage dam is to be built at the lower end of the McComber flat, on upper Battle Creek, in the Shingletown country, by the Northern California Power Co. The water will cover an area of 500 acres in its confinement. The object of the company is to have a reserve supply on hand when Battle Creek at this point becomes low during the latter part of the summer, and cannot supply sufficient water for the use of the electric generating plant at Volta. This dam has no association with the one they are contemplating building on Battle Creek for the new 12,000-horsepower generating plant.

Fresno, Cal.—A scheme for furnishing light and power to Death Valley, in California, and in and about Bullfrog, in Nevada, was revealed last week by the filing of claims in the recorder's office for water rights. The parties interested are R. W. Thomas, Wm. Snyder, H. E. Woodward and F. S. McKee. Power plants are to be established at various points on King's River, an immense amount of power being obtainable from the numerous tributaries. The mines of Southeastern California have long lacked both water and power for developing purposes.

POWER AND LIGHT PLANTS.

Tumwater, Wash.—The Olympia Brewing Co. will erect a large electrical power plant here.

Rockford, Wash.—Council awarded contract to the Rockford Light & Power Co. for twenty street lights.

Tacoma, Wash.—The Davies Electric Co., capital $150,000, has been incorporated by M. C. Davies, H. W. Davies, A. W. Lewis and E. C. Wheeler.

North Yakima, Wash.—It is reported that the new plant of the Northwest Light and Power Co., located twelve miles up the Naches River, will be completed in April.

New Westminster, B. C.—V. W. Hunt, of the B. C. Electric Ry. Co., has been appointed engineer in charge of the work of installing the new water power units at Lake Bunt-

Leavenworth, Wash.—Bids will be received by Guy A. Hamilton, city clerk, until April 23rd, for an electric light and water franchise.

Fallon, Nev.—It is stated by government engineers that the United States government is planning to erect a power plant on the Truckee-Carson irrigation canal.

Astoria, Ore.—The Astoria Electric Co. has awarded contract to W. S. Dole & Co., of Portland, for the construction of its new gas plant here, to cost $12,000. C. A. Coolidge, general superintendent.

Albany, Ore.—The Sanitam Electric Co. is arranging for the construction of seven power canals along the North Sanitam River. Joseph M. Healy, of Oregon City, is interested.

Boise, Ida.—The promoters of the Oxbow project will build a line to this place, a distance of 105 miles. The project is being developed by W. and S. Mainland, Oshkosh, Wisconsin.

Chihuahua, Mex.—The company owning the Pinos Altos Mines is preparing to put in a hydro-electric plant about three miles from the little town of Pinos Altos. The surveys have been made by J. H. Cooper, of Parral.

Kingman, Ariz.—George M. Chartier, and others of Los Angeles, have been here in conference with Superintendent Porter, of the Goldroad Mining Company in regard to the proposed electric power plant at Kingman.

Helena, Mont.—Work has been completed on the dam and power plant of the Helena Power & Transmission Co., on the Missoula River near here. The plant has a capacity of 15,000 horsepower.

Kalispell, Mont.—O. V. Farrar, superintendent of the Flathead Valley Water Power Co., states that new machinery is to be added to the Big Forks system to increase the capacity 750 horsepower.

Seattle, Wash.—The estimate for the installation of the cluster lights on Third Avenue, Third Avenue South, Prefontaine Place and Fourth Avenue South, as prepared by the city engineer, is $104,100.

Tacoma, Wash.—Manager E. J. Felt, of the Pacific Traction Co., announces that his firm would in a short time begin the erection of a 40,000-horsepower electric plant in or near this city.

Boise, Ida.—The Great Shoshone & Twin Falls Water Power Co., capital $1,500,000, has been incorporated for the purpose of taking over all the property of the Shoshone Falls Power Co., Ltd., at Shoshone and at Twin Falls. W. S. Kuhn, of Pittsburg, Pa., is president.

Bellingham, Wash.—It is reported that Stone & Webster will build a large addition to its Nooksack Falls plant to cost $500,000 to supply power for the new cement plant to be erected at Kendall by the Northwestern Portland Cement Company.

Tacoma, Wash.—It is reported that H. E. Salisch will erect a large power plant on the Nesqually River, near Elbe. Plans are being prepared by the Westinghouse Electric Mfg. Co. for the complete electrical equipment and construction of the plant.

Los Angeles, Cal.—The city council has approved a conduit map providing for the erection of an electric power plant on Division Creek, in Owens Valley. This plant is to furnish power to be used in driving the big tunnels along the right of way of the aqueduct.

Chihuahua, Mex.—A contract has been signed with S. P. Applewhite, of Mexico City, for the development of electric power in the Rio Grande district of Cuicatlin, State of Oaxaca. Mr. Applewhite proposes to supply electricity to Oaxaca and vicinity.

Aberdeen, Wash.—It is definitely announced that the Grays Harbor Railway & Light Co. will at once begin work on an immense power house near Electric Park. This plant and other contemplated improvements will cost $250,000. The main building will be of brick, 100 feet square.

Williams, Cal.—C. L. Schaad, president, and S. A. Lindstrom, electrical engineer of the Colusa County Telephone Company, have been spending some time at Fonts Springs planning a system of flues, dams and pipe lines for a power system at that place. The waters of the North, Middle and South Forks of Stony Creek are to be brought to a common point where there is a fall of 600 feet to the site of the power house below.

New Westminster, B. C.—The B. C. Power & Electric Company, Ltd., has filed an application for 3,000 miners' inches of water to be taken from the Squamish River and the Cheakamus River and its tributaries. The water is to be used in operating a huge plant for generating electricity for heating, lighting and power for manufacturing, industrial and mechanical purposes. The difference in altitude is about 300 feet, and the water will be conveyed to the required spot by means of dams, pipes, flumes and ditches.

TELEPHONE AND TELEGRAPH.

Oregon City, Ore.—Council granted a franchise to the Home Tel. Co.

Dillon, Mont.—The Bell Tel. Co. has commenced stringing wire from here to Salt Lake City.

Chehalis, Wash.—The Home Tel. Co. has applied to county commissioners for a 25-year franchise.

Dayton, Wash.—The P. S. Tel. & Tel. Co. propose installing the central energy system at this place.

Moscow, Ida.—The Inter-State Telephone Co. will shortly install a new common battery board.

Fernie, B. C.—The Revelstone, Trail & Front Lake Tel. Co. will build a long distance line to Elkmonth and Hosmer.

Bellingham, Wash.—Thirty men are at work preparing for the installation of new instruments for the Sunset system.

Maple Falls, Wash.—The Maple Falls Tel Co. has been incorporated by John P. Ashlund, H. J. Strickfaden and D. M. Stewert.

Lynden, Wash.—James Trapman has been awarded the contract for erecting the Farmers' Tel. building to be 18x26 feet, to be built of concrete and brick.

Edmonds, Wash.—The Independent Tel. Co. of Seattle has obtained a franchise for a local exchange. They will erect their own building for use as a central exchange.

TELEPHONE AND TELEGRAPH.

Bakersfield, Cal.—The Board of Supervisors has granted permission to the Standard Oil Co. to lay a pipe line and erect a telephone line along the county roads.

Asotin, Wash.—F. B. Simpson, who has had supervision of the Asotin Tel. Co., has sold his interest to J. N. Cunningham, of Clarkston, for $3,500.

Dillon, Mont.—Clay Patterson was elected president of the Dell Tel. Co. Construction work on the lines will be started as soon as supplies can be secured.

Umatilla, Ore.—The Farmers' Co-operative Tel. Co., capital $5,000, has been incorporated by Omer O. Stephens, De Witt C. Brownell and John W. Duncan. They will build, construct and maintain telephones in Umatilla County.

Spokane, Wash.—M. A. Phelps, president of the Interstate Telephone Company, announces that the temporary quarters on Post Street will be made permanent, and in addition to this it is purposed to establish a number of substations. He added:

"Our Coeur d'Alene exchange is now being installed, and we expect the work to be completed in a short time. We are also establishing an exchange at Post Falls. We are now extending our lines from Granite to Thompson Spur, in Idaho, a distance of five miles."

Spokane, Wash.—M. A. Crumbacher, of the Pacific Telephone and Telegraph Company, announces that plans have been completed to install a common battery system at Dayton, Wash., to cost $15,000. The present system of ten-party residence and four-party business lines will be abolished for four-party residence and two-party business. Although the installation of the new system will be a radical change, the subscription rates will remain practically unchanged.

Spokane, Wash.—W. J. Mogridge, of Spokane, has been awarded a patent on a telephone receiver holder. The receiver is held in place by a light metal frame, which is attached to the transmitter. When not in use the receiver rests on a small bar, which automatically opens or closes the connection. When tilted forward for use the receiver is brought in position for the ear without requiring the support of one's hand, so that the person talking is allowed the use of both hands. It may be attached to either a desk or wall phone.

Spokane, Wash.—Extensive alterations and improvements are being made by the Pacific Telephone and Telegraph Company in its Spokane system, and when these are completed it is announced between 14,000 and 15,000 instruments will be in operation. The entire system is being overhauled, and with the installation of the new switch-boards the capacity will be increased from fifteen to twenty-five per cent. The company has unfilled orders for from 800 to 1,000 phones, but under the old system it was out of the question to put them into service. The principal change is to cut out the express system, now in use, and install the central energy system.

Spokane, Wash.—Resolutions adopted without a dissenting vote by the council of Sandpoint, Ida., northeast of Spokane, are designed to compel the Bell Telephone Company to vacate, within thirty days, the streets and alleys in the town taken without authority or franchise. The town counsel declares that the council never granted more than permission to the company to operate a toll station, but in the face of this the concern has taken possession of the streets and alleys and is doing a local business as if fully empowered by franchise. The council declines to grant a franchise to any company without binding it to unite with the other companies on local business, with a view to saving the people the necessity of having more than one instrument in their homes and places of business. The Bell Company declines to accept a franchise with such a limitation.

Eureka, Cal.—An improvement campaign which will cost about $125,000 has been laid out by the Pacific Telephone & Telegraph Co. A. E. McLaren, the local manager, declares that the improvements will be begun in a few days. A telephone exchange is to be built and a general overhauling of the company's outside equipment is also scheduled, together with the installation of a switch-board and tool-board, both of the latest type. The new building will be two stories high and will cover an area 49x70 feet. The plans are now being drawn by the engineering department, and the actual construction will be commenced in a few weeks. At Arcata and Ferndale additional sections are to be added to the switch-boards.

Oakland, Cal.—Improvements to the amount of over $1,000,000 will be made immediately by the Pacific Telephone Co. in its plant in this city. Among the improvements contemplated are remodeling the main office on Franklin street by building an extension which will enable the company to use the present operating room for the switch-board service of the company. The number of operators will be increased by twenty-five. It is proposed to put the outside wires all on cable basis, and these changes will be made at once. The East Oakland, Berkeley and Alameda offices will also be materially enlarged and the service generally improved. One of the main features of the improvements in prospect is the laying of a large number of underground cables.

TRANSPORTATION.

San Diego, Cal.—A strong possibility exists that the proposed extension of the Bartlett electric railroad system to La Mesa Springs and El Cajon Valley will be paralleled to a certain extent, at least, by the Spreckels lines.

Monterey, Mex.—A new company has been formed in San Pedro for the purpose of constructing a street car line in that city. The company is headed by Andros Medellen, who is president, and Manuel Gonzales, who is secretary and treasurer.

Reno, Nev.—Col. Hopkins has started surveying for his electric car line from Reno to Steamboat Springs, twelve miles south of this city. He states that the line will be surveyed and completed in four months. It will later be built to Carson City.

The JOURNAL OF ELECTRICITY
POWER AND GAS
WITH WHICH IS INCORPORATED
The Engineers', Architects' and Builders' News

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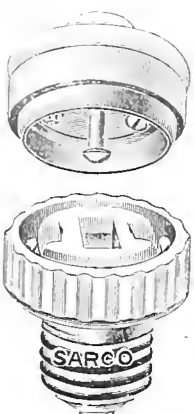
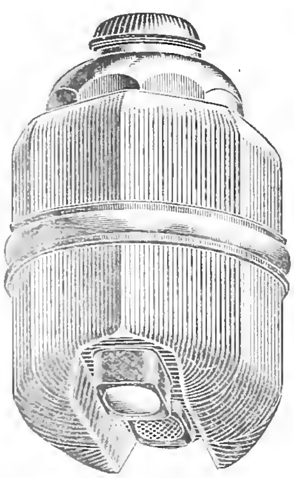
Two Plug in One



Separated

Separable and Swivel



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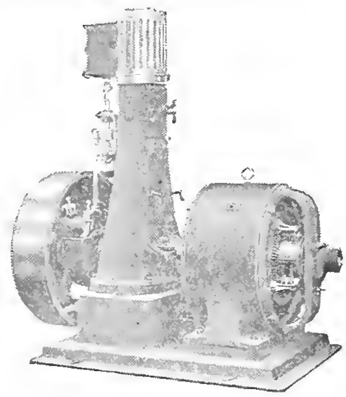
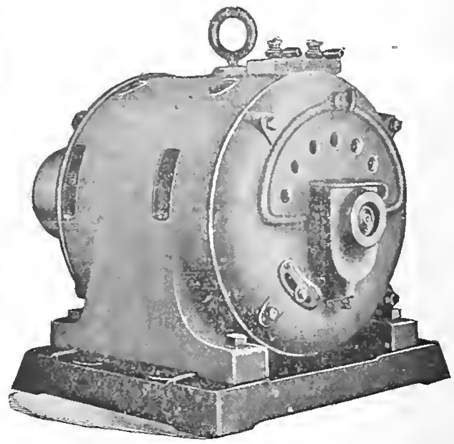
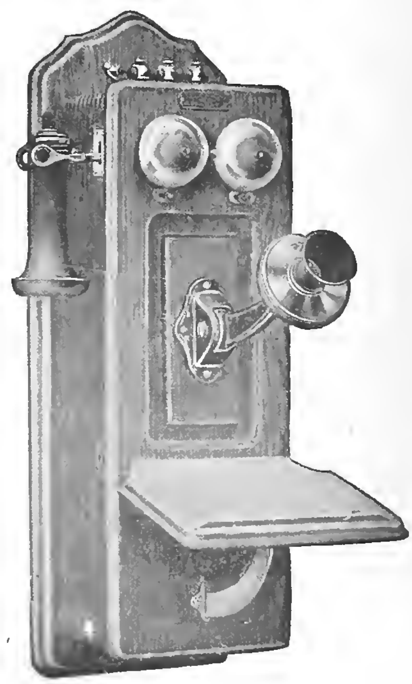


Generating Sets



Century A. C. Motors



Long Distance and Intercommutating Telephones

STANDARD ELECTRICAL WORKS

58 & 60 Natoma Street Phone, Temporary 894 SAN FRANCISCO, CAL.

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The Engineers' Architects' and Builders' News

VOLUME XVIII. SAN FRANCISCO, CAL., MARCH 30, 1907 No. 13

The Restoration of Telephone Service in San Francisco

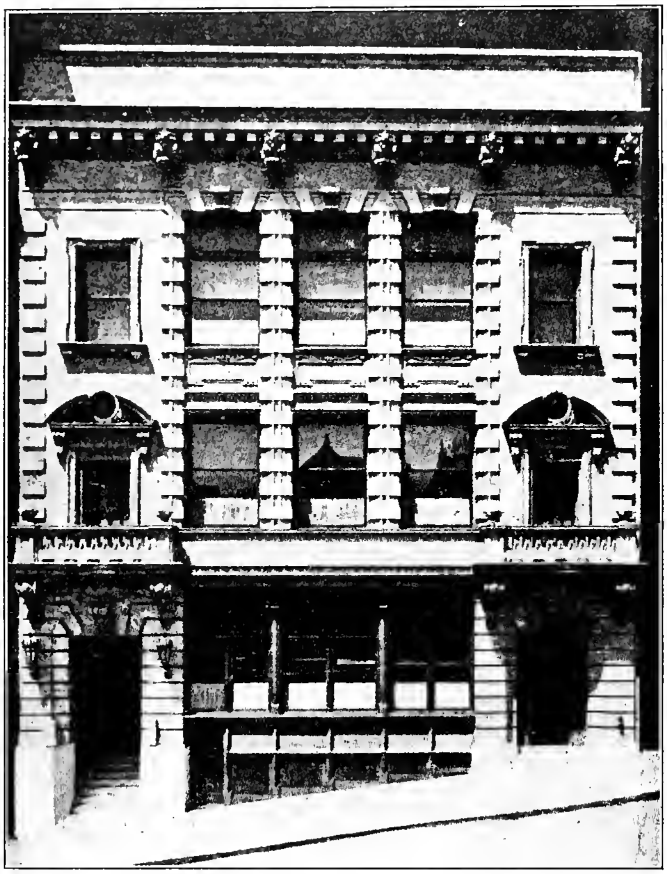
Just previous to the disastrous fire which swept over San Francisco after the earthquake of April 18, 1906, the Pacific States Telephone and Telegraph Company had in use in that city about 52,000 telephones which were served from eight exchanges located in various parts of the city. The Main, Mission, South and Chinatown exchanges were totally destroyed, as well as the equipment in the East exchange building, which, being of class "A" construction, withstood the intense heat, although the contents were entirely destroyed. These five exchanges served about 38,000 telephones, and the loss of their equipment greatly complicated the work of restoring telephone communication.

A TELEPHONE EXCHANGE IN CHINATOWN PREVIOUS TO THE FIRE.

Practically all the improvements which the Telephone Company had made, or had partly completed, during the preceding five years in expanding and modernizing it system to keep in pace with the growing demands of the city, were reduced to heaps of ruins. The East exchange, previously mentioned, which is at 821 Hyde Street, had been in use just about a year. The switchboard was equipped for 8,000 stations with an ultimate capacity of 18,000 stations.

In addition to the exchanges in use at the time, a three-story brick building had just been completed at West Mission and Herman Streets, and a multiple switchboard, equipped

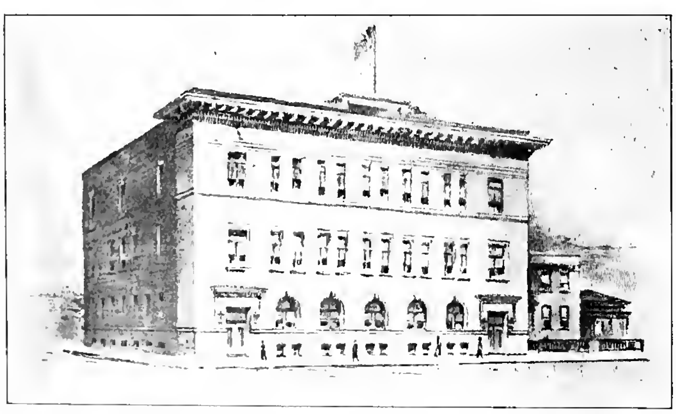
for 20,000 stations with an ultimate capacity of 40,000, had already been installed. This new exchange was to be opened on May 1st, 1906; the telephones served from the South, Mission and Park exchanges were to be operated from this one, which was to be known as the Market Exchange. The fire penetrated the upper floors of the building and com-



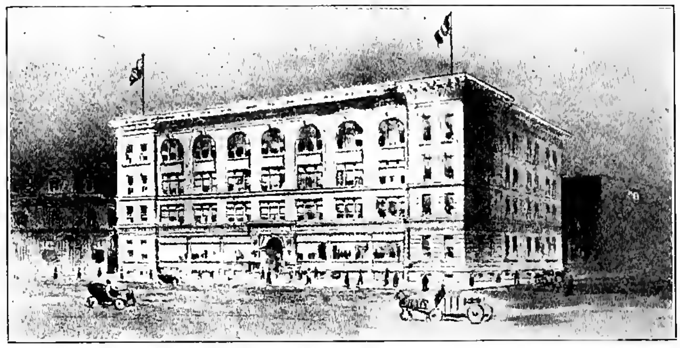
East Exchange Building, 821 Hyde Street, as it stands to-day, completely restored and serving 4,000 telephones.

pletely destroyed the switchboard, though part of the remaining equipment was saved and used for refitting the exchange.

A new eight-story, class "A" building had been erected at 445 Bush Street, and considerable work had been done on the installation of a new multiple switchboard for local service and a toll board for the accommodation of the long-distance lines. This exchange was to constitute the Main exchange, and was to have taken the place of the old "Main" exchange in the six-story brick building located at 216 Bush Street, which was destroyed in the fire. Had normal conditions prevailed this exchange would have been ready for service in July, 1906. The multiple board was equipped to accommodate 30,000 telephones, with an ultimate capacity for 50,000. The toll board was equipped for the control of 150 long-distance lines. The building itself withstood the ravages of the fire, but the contents were a total loss.



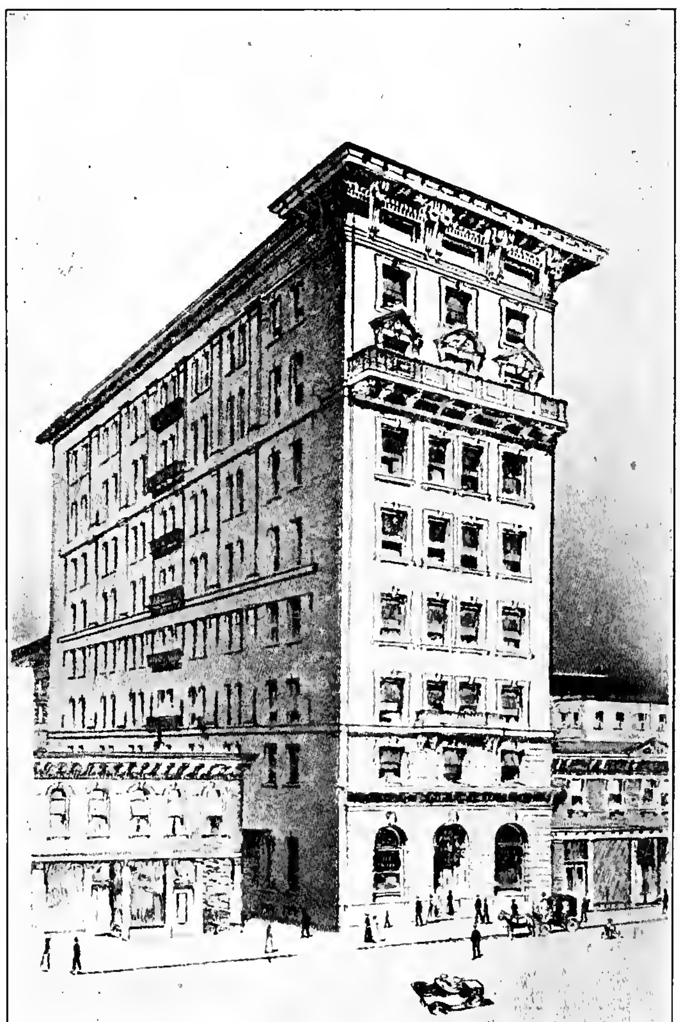
Market Exchange Building, West Mission and Hermann Streets, restored since the fire. This building, with switchboard equipment, was to be ready for service May 1st, 1906. The fire penetrated the top floor and consumed the switchboard. The switchboard installed in this building since the fire is serving 5,000 telephones.



Executive Building, 140 New Montgomery Street, completed in February, 1906, and occupied but two months prior to the fire. This building a total loss by fire.

The new four-story brick building at 140 New Montgomery Street, in which the executive offices of the company had been located since the preceding February, was burned to the ground.

Those exchanges, which were untouched by the fire and on which the burden of supplying the much-needed telephone service fell, were the West exchange, at the corner of Pine



New "Main" Exchange Building, 445 Bush Street, as it stands to-day and restored since the fire. This building was completed just before the fire, but not occupied. The switchboard equipment being installed at the time of the fire was a total loss.

and Steiner Streets, and the Park exchange, on Page Street. The Butchertown exchange, at the corner of First and Railroad Avenues, was also saved, but on account of its size and location was of little importance. The West exchange was only partly completed, and was limited in the number of subscribers it could serve. The Park exchange was a small one, and was to have been abandoned when the new Market exchange was to be opened, as before mentioned.

With the overhead wires in the burned district entirely gone and those in the unburned district broken and tangled, snapped by the force of the earthquake or cut down in clearing the trolley wires for the operation of the street engines, the service which the company was able to give during the first few days after the fire was necessarily greatly limited. A large force of men was employed to place distributing poles throughout the burned district at points where the underground cables could be tapped, as before the fire they had distributed into the various buildings through cables running into the basements.

The Citizens' and Relief Committees were the first to receive consideration from the Telephone Company, and steps were immediately taken to install telephones for their use. The telephone stations at the Ferry Building received immediate attention so that there was connection at all

A PICTURESQUE INTERIOR IN CHINATOWN. THE CHINESE ARE CONSTANT USERS OF THE TELEPHONE.

cars, and with the supply of electric power cut off, the problem of restoring telephone connections was not an easy one. Fortunately the underground systems were but slightly damaged, and steps were immediately taken to get them ready for use. In the meanwhile switchboards and other apparatus were ordered by telegraph to be shipped immediately by express.

Steps were taken at once to prepare the West and Park exchanges for service. Gasoline engines were employed to drive the generators for supplying current for charging the storage batteries. On account of the small capacity of these

times from this place to Oakland.

On April 28th, seven days after the fire had ceased to burn, the first telephone list was printed. It contained the numbers of thirty telephones which had been connected for the accommodation of the various relief committees, the hospitals, newspaper offices, the Board of Public Works and other branches of the city government.

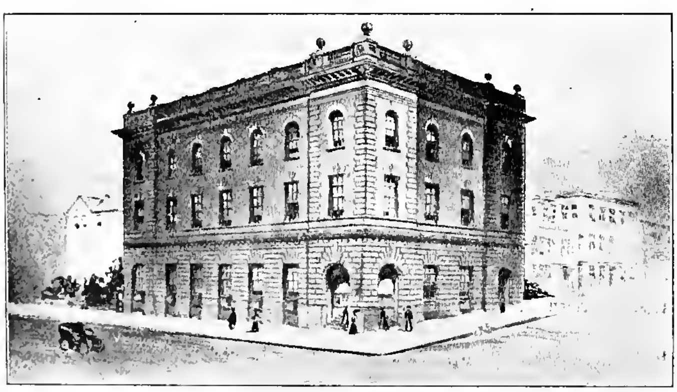
With the gradual resumption of business and its transfer to congested sections of the unburned district where the systems of distribution had not been designed for such an emergency, the entire redistribution of the underground ca-

bles was necessary. Many hundreds of feet of cable had to be pulled through the conduit and spliced up. Since these cables carried from 50 to 400 pairs of wires, the splicing required considerable time and care, as each wire must be properly paired throughout the entire length of the cable. A large force of men was employed to clean up enough space on the lower floors of the buildings at 445 Bush Street, 821 Hyde Street, and that at the corner of West Mission and Hermann Streets to serve as temporary quarters for the switchboards ordered by express. Additions were made to the switchboards at the West and Park exchanges as soon as the necessary equipment could be obtained. Much of the work had to be done at night by the light of candles and

CONDITIONS UNDER WHICH OPERATORS WORKED JUST AFTER FIRE.

lanterns, and it was necessary to establish commissary departments for the benefit of the workmen.

On May 12th, less than one month after the fire, the first telephone directory in book form was issued. It contained the names of 2,880 subscribers, all of whom received connections through the Park, West and Butchertown exchanges. On May 23rd the new Main exchange at 445 Bush Street was opened, and on June 9th the new Market exchange at West Mission and Hermann Streets was ready for service. The equipment in both of these exchanges is, however, only temporary. On September 15th the new Franklin exchange



West Exchange Building as it stands to-day. This exchange, located outside of the fire line, was not damaged, and was one of the two exchanges intact after the fire. It has been doubled in size since the fire, to meet the growth of that district.

was put into service with a permanent equipment.

The following figures are significant of the progress made during the past eleven months in meeting the demand for telephone service in San Francisco:

Telephones in use two months after the fire.....	9,071
" " " three " " " "	10,975
" " " six " " " "	18,270
" " " eleven " " " "	27,537

This is a creditable showing, in view of the great difficulties of obtaining the necessary equipment and labor, and is an excellent indication of the rapid restoration of normal conditions in San Francisco.

The work of building and equipping the new permanent exchanges is progressing rapidly. It is expected that all of these will be ready for service before the end of the current year.

SMALL ELECTRICAL DEVICES NEED CONSIDERATION.

A recent disastrous fire—disastrous in that it caused the destruction of a magnificent home—was caused, it is said, by the negligence of a servant using an electric flat-iron. Whether this statement is true or not is immaterial, but in view of the charge, the "Electrical Review" points out that small electrical household devices need a certain amount of consideration. This statement is true of any utensil in which heat is developed, but the public seems to think that because it sees no flame there is no possibility of fire. No servant, however thoughtless, would throw a towel around a lighted gas lamp; yet how many appreciate the possibility of a fire if the same treatment be applied to an incandescent lamp? It is not realized that an incandescent lamp, although it gives out considerably less heat than an oil or gas lamp when giving the same amount of light, still does set free heat in large quantities; in fact, the amount of heat given out by an incandescent lamp is equivalent to about one-twelfth of a horsepower. This statement will not convey much meaning to the uninitiated, though perhaps it may be impressive, but a more impressive way of illustrating the point is to wrap a towel around an incandescent lamp and see what happens. When the heat is thus confined, it will not only set fire to the wrapping, but may soften and melt the glass bulb. This fact is well known, and the insurance rules provide for it. In one sense of the word it constitutes a danger, but the risk from this source is comparatively small, since it is not customary to hang clothing on electric lamps; it is practically negligible in all properly-cared-for homes.

This is true of the incandescent lamp, and is true of any heating device. A curling iron, if left in circuit and wrapped up, a chafing dish, if completely enclosed, or a flat-iron, if left in circuit upon inflammable material, may start a fire. It is the function of the electric current to develop heat in the flat-iron. The amount of heat thus developed must be considerable, as in the process of ironing, a good deal of water must be converted into steam. If the heater be left in action, but the iron be placed so that it cannot get rid of this heat, the temperature must necessarily rise. It is possible to obtain some degree of protection against fire in such cases by introducing a thermostat in the heater, but this does not entirely obviate the danger of fire. Also, it is easy to arrange the iron so that the electric current will be cut off whenever it is released from the hand; but here again there is a possibility that the automatic switch may get out of order. The only sensible thing to do is never to leave the iron in a position where it can start a fire. In general, the danger is slight, but it should nevertheless be realized.

There are many other little electrical devices which are exceedingly safe when compared with other apparatus for performing the same operations, but it should never for a moment be forgotten that an electrical current represents energy; that all forms of energy tend to become heat, and that heat, if confined, may start a fire. Electrical apparatus as a class introduces less danger than any other, but it may become dangerous if abused.

LITERARY ENGINEERING.*

By George A. Wardlaw.

It is our purpose to consider only one of the many aspects of engineering activity, the aspect that finds expression in what is rather vaguely phrased as technical literature. In rather marked contrast to the fine imaginative qualities—the daring, the cunning, the patience shown by the engineer in conceiving, designing, constructing, and operating apparatus, is the lack of literary imagination indicated by the dearth of clear and forceful expression in what we have agreed to call technical literature. As revealed in technical literature, the style shows that the engineer is strangly indifferent to the codes of grammar, rhetoric, and idiom established by recognized good use. While his engineering conception and execution are virile, his literary expression is unmistakably weak. The elements and qualities of style are more or less ignored, forgotten in the prevailing tendency to sacrifice everything to what is quaintly phrased as "doing things." So intently does the engineer pursue this commercial siren that he has neither time nor temper to bother with mere verbal expression. As a scribe he is frequently found doing things that smack of engineering heresy, or that indicate a limited conception of the idea embodied in the mystic word, efficiency. More often than not his literary expression of engineering activity is so peculiar that the proverbial editorial blue pencil is also kept busy "doing things" in the effort to produce efficiency by harmonizing the literary expression with the engineering facts. If there is one word that engineers harp on it is the word "efficiency." Efficiency is the engineer's ultimate test of the worth of any piece of apparatus; inefficiency is its death-knell. As we shall show later, this is equally true of all technical composition, whether the composition be a machine or a descriptive article.

If, then, we are to give literary expression to engineering activity we should be willing and anxious to make this expression conform to the writer's art, the art of putting sound sense in pure language. This art is long and arduous, but it is worth all that it costs in time and labor. The acquiring of it reduces the likelihood of misunderstandings; with fewer misunderstandings we shall have fewer quarrels and lawsuits, and the fewer the quarrels and lawsuits the more our efforts will make for efficiency and happiness. In literary work, efficiency and happiness can be approached, indefinitely at least, by a judicious application of the principles governing the elements and qualities of English composition; these principles can be acquired by absorbing the substance of any good text-book of rhetoric, and their application can be found in the works of the masters—the classics. Occasionally there arises a genius whose activities, engineering and literary alike, refuse to be curbed by ordinary methods; whose literary expression is regulated, not by the principles of composition, but by a sort of divine inspiration. But as most of us are ordinary grubbing mortals with commonplace talents, it were best perhaps, in giving literary expression to engineering activity, to follow, not the vagaries of the soaring genius, but the dictates of common sense and the mandates of good use. In clearness lies our strength; in vagueness, ambiguity, or obscurity lies our weakness, a weakness that indubitably tends to retard the attainment of the professional dignity and recognition to which we are entitled equally with the physician and the lawyer.

This problem of clear expression in technical literature is not a mere academic one; it is one of the most practical problems with which the engineer has to deal. Lacking clearness a specification might result in professional and financial ruin to the unwitting and unfortunate author or client. While deciphering a vague or obscure passage, important work might be irretrievably delayed. Owing to the scarcity of the mental lubricant, lucidity, there is much needless friction, resulting in the loss of time, energy, aand perhaps money. In short, as a literary machine the non-lubricated engineer would prove inefficient and detrimental to the best interests of his client. It has been well said that he who can express his thought readily and clearly can usually command what he wants.

So urgent is the need of better literary expression among engineers, that at the last annual convention of the American Society of Civil Engineers, Mr. Bernard R. Green is reported as expressing the following views on this vital subject: "Engineering literature, descriptive or critical, of undertakings or accomplished works, or of the experiences of difficult construction, is thin and scarce. Engineers have not written enough, do not write well enough, and do not like to write because they do not know how. This is because of the insufficient training of the past generation that prevented ease and fluency in writing by one intensely engaged in practical work. Consequently, many valuable experiences and ingenious accomplishments, which might have been invaluable to others and to the world, have lived and died in the minds and memories of the engineer geniuses, to whom the labor of concise and readable records was irksome and laborious."

Clearness of expression, then, setting aside for the moment the other and higher qualities of style, has but little charm for the engineer. Clearness is for the nursery. The Philistines tell us that what the engineer wants is forceful expression and plenty of it. This is the quality of style that best interprets engineering activity. Did the engineer but know it, clearness is infinitely easier of attainment than force; for force requires exact diction and extreme brevity—it is attained, not by the use of many words, but by striking out the needless words and phrases, and then deliberately weakening the intensely vigorous passages. In short, force is rarely attained; and clearness of expression—using the right word in the right place—it seems, varies inversely as the complexity of the subject. The long involved sentence is one of the characteristics of an engineer-author.

This state of affairs is unfortunate, unfortunate for the engineer-author and the reader alike, for it tends to confuse and bewilder the reader while it reflects seriously on the quality and breadth of the engineer's mind. His facile technical mind is not only poorly reflected but also frequently distorted when mirrored by manuscript or type. Among editors and proof-readers he is ever on the defensive, and the members of the so-called learned professions look at him askance. This attitude reached its climax several years ago when an eminent individual in addressing one of the national engineering societies, advised its members not to join in a laborers' strike. Where that eminent individual got his notions is hardly pertinent to this talk; the incident is cited here merely to show how we are thought of by other professional men, even though we may assume a top-lofty attitude and pity their ignorance of present-day intellectual development in the scientific world. Maybe that eminent individual's notions regarding the lack of culture in the engineering profession, and consequently the engineer's social status, were induced by the reading of a few unedited manuscripts!

Words.

So much for this interesting subject in perspective; now let us consider it somewhat in detail. We have said that many of the literary expressions of engineering activity are inefficient because the quality of force is rarely attained, and that of clearness seems to vary inversely as the complexity of the subject. Clearness, we agreed, is attained by using the right word in the right place, and force by using the fewest words that the subject will bear. Much of the literary expression of engineering activity errs in these particulars simply because the engineer is so rich in ideas and so poor in words that he finds it hard fully to express the one in the other. The ideas are so many and the clothes so few that his best thoughts frequently masquerade in misfits or motley, and sometimes they are so adroitly masked that even the author

*Abstract from a lecture delivered before the engineering students at Cornell University.

fails, after a brief lapse of time, to recognize the products of his mind.

Subjecting the literary express of engineering activity to a cursory examination, we find our authors taking strange liberties with the language, with the code of good use as recorded in the grammars and dictionaries. It were needless to multiply examples of engineering solecisms; a few taken at random from manuscripts written by practicing engineers will serve our purpose. Singular subjects, we find, are often coupled with plural predicates, and singular predicates with plural subjects. "Data is," "data was," "this phenomena," "each of these types have," "none of the machines have"—all these occur frequently in literary engineering. The past and present tenses are often confused, and shifting from the active to the passive voice is not uncommon. More common still is the shifting in the same sentence from one person to another, as will be seen in the following utterance: "I say, if you want to standardize. you might as well stay where we are now and use what is here and what is known to be reliable rather than go to new types as recommended by them."

Splitting the infinitive is another favorite pastime, for we find almost endless repetitions of phrases like: "To materially affect," "to fully meet," "to clearly state." It would be well, perhaps, to amend literary engineering in this particular, for among the discerning the split infinite bears the same relation to literature that lack of consideration does to social behavior. Fewer split infinitives would no doubt better the English without hurting the engineering.

As long ago as 1817, Cobbett wrote to his son, saying: "The word 'it' is the greatest troubler that I know of in language. It is so small and so convenient that few are careful enough in using it. Writers seldom spare this word. Whenever they are at a loss for either a nominative or an objective to their sentence, they, without any kind of ceremony, clap in an 'it.'" The troubler is still doing business at the same old stand, and his kinsfolk, "their," "they," "them," have been taken into the firm. These pronouns are a prolific source of ambiguity: "By the arrangement shown," we read, "the centre of gravity will be low, and it leaves a compartment at one end." Here the grammatical antecedent of "it" is "centre of gravity," and to write in this way of the centre of gravity is to write nonsense. The centre of gravity is not yet an active verb. "Iron poles," we read in another place, "are to be avoided principally on account of danger to linemen and their short life due to rusting." This unique statement reminds us of the famous sign over the London bootblacks' stall, "English spoken; American understood." We understand of course that the poles do the rusting, even though the writer tempts us to believe the linemen guilty of it. Again we read, "The results secured from the machines are different every time they are thrown together." Here the writer means to say that the results are different every time the machines are thrown together, not that the results are different every time the results are thrown together, for the latter statement means nothing at all.

Occasionally we find a misplaced adjective distorting the author's meaning, but this offense is comparatively rare in literary engineering. Misplaced adjectives, though offending against clearness, are not dangerous, as we can usually guess the author's meaning. "In America," we read, "the underground electric cable manufacturing companies have refrained from publishing experimental data relative to cables." As the cable manufacturing companies are still above ground, this writer would have avoided ambiguity by recasting this sentence, so as to make it say what he means. He means to say that, "In America, the companies manufacturing underground electric cables have refrained, etc."

These few examples will suffice to show the engineer's scorn for mere grammar. His indifference to diction, though not quite so apparent, is more liable to misrepresent his thought. Paucity of vocabulary is, no doubt, responsible for many constructions that result, sometimes in ambiguity, sometimes in obscurity, sometimes in arrant nonsense. The use of "partial" for "part" in the sentence, "Partial reports were secured from other plants," is ambiguous, because it can be taken to mean reports that were not impartial. What the writer means is "part" reports, reports not complete. "Partial reports were secured for other plants," brings another matter to the surface, the matter of the use of the word secure as a verb. Though sanctioned by grammar, this verb and the participles "securing," "secured," are worked to death by engineer-authors. Nothing is obtained or got in literary engineering, everything is secured, as in the ambiguous sentence, "The readiness with which these plugs can be secured in any location." Other overworked words are eliminate, absolute, system, type, however, and, and our old friend, efficiency. Trifling with words, a well-known engineer makes this unique statement: "Considering the need for the better railway transportation as a solution of the traffic problem it follows, etc." The query arises here, when does the need of a thing solve the problem of getting it? Paucity of vocabulary, resulting in the use of general instead of specific words, is at the bottom of the following statement: "The problem is very much more difficult, due to the necessity of considering in the solution of an engineering problem not the particular problem alone, but in its relation to everything else that exists." We read elsewhere: "But in the past few years electricity has come steadily into use as a means of transmitting the operating power, until at the present time it is the prime element in signaling." Analyzing this sentence from the viewpoint of the engineer, we find it to say this: But in the past few years a form of energy has come steadily into use as a means of transmitting the operating rate of the expenditure of energy, until at the present time it is the prime element in signaling. This is sheer nonsense, caused by a careless use of rigid technical terms. At college we were at great pains to learn that energy is one thing, work still another, and power something that involves not only energy and work but also a time-element. We learned, in short, that work requires the expenditure of energy, and that power is the rate of doing work. Applying these rigid definitions to the words used in the statement quoted above, we find as already noted, a fine example of technical gammon. This use of general words where ample of technical gammon. This use of general words where the thought requires them to be specific is intensely human; we hate to be pinned down to facts; we shun precisions and schoolmarm diction as a pest and a bore.

We have considered this element of words long enough to realize that many of the faults in the literary expression of engineering activity are due to two things; inapt diction and grammatical heresy. Grammatical heresy, we admitted some time ago, to be due to the temperament and environment of our engineer-authors; inapt diction we believe is caused chiefly by paucity of vocabulary. This paucity of vocabulary, as we have said, is unfortunate; for it sometimes causes the engineer-author to array his best thoughts in motley. Careful reading of the classics will help materially to overcome both defects, for the classics are classics only because they put sound thoughts in pure language. Here the elements and qualities of style are handled with great delicacy of touch; the masters are at work painting word-pictures of rare merit; the right word is in the right place; there is harmony between verb and noun; pronouns are not uncertain about their antecedents; and the "lid" is on the split infinitive. There is clearness and force and efficiency. Prose classics for grammatical purity, then; poetry for clear and forceful diction; both alike for rhetorical beauty and literary efficiency.

Phrases.

It is perhaps too early to look for the engineering bard that can put in simple phrase the philosophy of engineering activity. Kipling's prayer—"God send a man like Bobby Burns to sing the song o' steam," is not yet answered. It may be answered some day; some day when the complexities of engineering activity and the inaccuracies of its literary expression are reincarnated in a holiday edition of power-house

lyrics and transmission line sonnets phrased in simple Saxon. Meanwhile we must be patient and gracious while our engineer-authors coin phrases that ill compare with those in Holy Writ and the other classics, phrases that fall far short of expressing the glory of the other side of the engineer's creative genius, for none but a master of phrase can do that genius justice.

In the absence of a master we find the literary expression of engineering activity abundantly supplied with phrases like these:

Along these lines.
In this connection.
Owing to the fact that.
On the one hand; on the other hand.
This is very significant.
Right here I want to say.
In addition to.
Amount of energy involved.
Which due to its.
Which due to this.
Which due to that.
It should be noted.
Referring to the point brought out by.
Mention is made of the fact.
Look into the question of.
Strike a balance.
Within the scope of.
That is to say.
In other words.

These phrases are in wide general use among our engineering men of letters. They are the fundamental tones in the engineer's organ of literary expression, the overtones taking the form of specific pet phrases that appear more or less frequently in all his compositions.

Two more phrases and we are done with this portion of our subject. During the last ten years probably two hundred engineers have said that the old guesswork species of engineering has been superseded by scientific engineering, phrasing their thought in this wise: "The slide-rule supersedes the rule of thumb." This expression is now a commonplace in technical literature, and should not be dragged from its well-earned obscurity and exhibited as a newly-discovered truth. Like the other phrases we have just considered, it is somewhat hackneyed, and cries to be allowed to dwell in peace. It is an old story now, and like other old stories its piquancy is gone.

By way of offsetting the professional cant phrases that we persist in reiterating, the layman persists in asserting that electricity is in its infancy. In its infancy, indeed! In this country electricity outgrew swaddling clothes years ago, shortly after the introduction of the duplex telegraph; it reached the hobbledehoy period during the development of the incandescent lamp; it arrived at young manhood during the development and application of the electric motor and the telephone. With the application of electricity to the New York terminals of the big trunk-line railroads, our infant will have attained the strength and the dignity of a full-grown man. The layman confuses the work with the word. If any aspect of engineering activity is in its infancy it is the literary aspect. The puerility of this aspect—the very thing we are considering—affirms that it is not practical engineering but its literary expression that has not yet arrived at maturity.

Sentences.

Efficiency is the ratio of result to effort. If after a reasonable amount of mental effort an intelligent and educated person be unable to detect an author's meaning, then the composition may be said to be inefficient. We have seen that inapt diction is the cause of some of the existing confusion in the literary expression of engineering activity. General phrases we have proved to be somewhat of a dead lift, in that failing to sharpen and vivify the thought they merely encumber the expression with useless words. Some other phrases in general use add nothing to engineering knowledge, because, as admitted commonplaces, they merely—"say'st an undisputed thing in such a solemn way."

Having seen some of the results caused by indifference to the use of words and phrases, now let us look into the engineer's attitude regarding the use of sentences. We have asserted that many engineers frame sentences in vague or ambiguous or obscure language, sentences that are not intended to mean what they say, and sometimes don't say what they mean.

We are told that there is a close relationship between clear thought and clear expression; clear thinking, it is commonly asserted, must precede clear expression. True. But this is not all. Clear thinking doesn't produce clear expression any more than a clear track is a guarantee of the safe arrival of a train. Inapt diction or faulty syntax will ditch a train of thought just as quickly as a broken axle will ditch a train of cars. No matter how well informed an engineer is on his special branch of engineering activity, no matter how clearly he thinks about his subject, he may still fail ignominiously when he tries to express his thoughts in writing. In a public engineering paper—a contract, a specification, for instance—inapt diction or faulty collocation is as menacing to all concerned as a misplaced switch or an open draw-bridge is to a fast-moving railway train.

It has been well said that in no language of culture is the order of words of such high importance as in English, from its having lost almost all of its inflections, or suffixes expressive of relation. A recognized authority on literary good use, Professor Barrett Wendell of Harvard University, informs us that theoretically every sentence should have unity, coherence, and mass. It should treat of one thing at a time; the parts should cohere, stick together; and the parts should be massed so as to have principal and subordinate features properly placed. For the present we shall overlook the quality of mass; unity and coherence are the only qualities that we shall find immediate use for. The text-books tell us to join matters that belong to the same thought; to separate those that are distinct. This is the principle of unity, the most important principle in English composition. It is the violating of this principle, the trying to say too many things at the same time, that causes no end of trouble in sentence structure. When this principle is violated the composition is loaded with "ands" and "buts," resulting in a loose, rambling sort of style that says a great many things, but nothing quite clearly.

This is often the style of the scribe who would fain elucidate some abstruse problem in alternating-current work. His thought may be clear, but his expression is so crude that by and by we are in a hopeless jumble of electrical facts, mechanical or hydraulic analogies, "ands," and pronouns with doubtful antecedents. Here is a case in point. We read: "Considering an electric current to be represented by an elastic fluid, flowing under pressure in a pipe, an inductance is well represented by a fluid motor carrying a heavy fly-wheel. On suddenly starting a direct current through the line carrying such an inductance"—such an inductance is specific and the only inductance specified here is the fluid motor—"the current will have some trouble in establishing itself until the wheel"—here the author has the current and the wheel somewhat confused—"is well under way, after which it will proceed hindered only by the friction or resistance of the apparatus." Here we have the analogy mixed up with one of the properties of an alternating-current circuit, and later we are confronted by an "it" that leaves us in doubt as to whether the author intends the wheel or the current to go on its way.

The following sentences possess unity—each one dwells on only one thing—but the absense of coherence, the faulty collocation, leaves us uncertain whether the authors mean just what they say or something entirely different. The chief engineer of a large electric railway company says: "I will not have men who have not had a college training at the head of any department." This is nonsense; college training

is not usually obtained at "the head of any department." A slight transposition of words is all that it needed to make our chief engineer's expression consonant with his thought. A prominent western engineer says this: "It would be interesting to learn the experience of members of the profession with greased trolley wires." This needs no comment. Again we read: "The writer has been advocating multiple-conductor cables for arc circuits instead of several cables in the same duct in trunk lines for a number of years." In this case we know what the writer means because we happen to be familiar with the subject, but several transpositions must be made before the word truly represents the facts.

We find lack of both unity and coherence to be responsible for the following bit of nonsense: "Various formulas have been given heretofore for the determination of the leakage coefficient of induction motors, all of which differ, however, widely from each other in the results derived therefrom." We turn this into sense; first, by preserving the unity; we insert a full stop instead of a comma after "motors." Then we transpose the second sentence to read as follows: "The results derived from these formulas, however, differ widely from one another." Taking the following classic utterance in order, we find the first vague; the second half vague, half obscure; the third flagrantly violating in one sentence all the principles and qualities of literary good use. To quote Professor Barrett Wendell: "It would be hard to find in equal space a better example of obscurity."

1. "It would take more kilowatts in the short circuit on its alternating side to make the motor-generator run away than the converter."

2. "While none of us can tell with any degree of accuracy, what the ultimate growth of the transformer will be, the speaker thinks we are in better condition to-day to form conclusions than was the case 12 years ago in regard to the transformer as it is at the present time."

3. "The complexities which will be introduced by multiplying the output and voltage of the induction coil are such that the distinction between the magneto and the largest generator in the world will not be found an ill-advised simile for the difference between the simplest form of transformer and the large high voltage units which are now being designed and made."

Figures of Speech.

There are two kinds of men that use figures of speech correctly and effectively, the untutored savage and the highly trained artist. The artist knows the insidious wiles of mixed metaphor, and seeks deliberately to avoid them. He knows the penalty of kaleidoscopic literary effects. The life of the untutored savage is simple; he has but few wants and uses but few words to express his thoughts. Intuitively avoiding mental complexities, he illustrates his thought by a grunt, a shake of the head, a wave of the hand, or a few short words that suggest something altogether trite and homely. His figures are so few that it is almost impossible to mix them.

As most of us are neither savage nor artist, the chances are largely against our making rational mental pictures, so the fewer figures we use perhaps the more lucid our expression will be. At any rate we would not be telling lies, as it is a truism that a mixed metaphor is at least an unconscious lie. It is attempting to depict something that we know does not exist.

Occasionally our engineer-authors venture into this field of literary endeavor, but not often; the subject of engineering activity is almost too prosaic. The proper place for figurative language is in poetry, and, as we have already said, engineering activity has not yet found expression in a holiday edition of power house lyrics. When engineers do venture into this field they produce some startling effects, tragic or comic according to the humor of the reader. Here for instance is the sentence we considered together some time ago. "The complexities which will be introduced by multiplying the output and voltage of the induction coil are such that the distinction between the magnets and the largest generator in the world will not be found an ill-advised simile for the difference between the simplest form of transformer and the large high voltage units which are now being designed and made." Here we find that the complexities introduced by multiplying two things are such that the distinction between two other things will not be found an ill-advised simile for the difference between two more things. Just what this simile is some of us would no doubt like to ascertain.

A doctor of philosophy writes: "The thin edge of the wedge of competition that has been inserted, has served to awaken considerable dormant energy, the fruit of which cannot be estimated."

A well known operating engineer has this to say about a piece of protective apparatus: "It was thought that the keynote of this situation laid in the development of a time-limit relay."

Here, laid is the past participle of the active transitive verb to lay. What this musical metaphor is capable of laying is beyond comprehension, unless it be other keynotes—a brood of keynotes that may eventually result in a grand electrical symphony.

An eminent engineer in speaking of the pole-line construction of high-tension transmission line says: "The set of downwardly projecting fingers about half way up the pole forms a sort of cow-catcher to prevent people climbing the pole." This suggests one or both of two things; first, that cows are wont to climb poles; and secondly, that people are cattle.

Conclusion.

This contrast between engineering activity and its literary expression is not caused by inherent incompatibility of temper, for efficiency can be attained in the one as readily as in the other, and by much the same means. All engineering authorities affirm that to produce an efficient machine we must plan and build in accordance with well-established engineering principles. Having completed the plan we select the materials and put them together in a more or less arbitrary way—all the details of planning, selecting and building, being so adjusted as to produce a useful and economical contrivance. All literary authorities affirm that to produce an efficient composition, we must plan and build in accordance with the dicta of literary good use. Having completed the plan, we select the words, arrange them in sentences, arrange the sentences in paragraphs in logical order, concluding with a concise summary—all the details of planning and arranging being so adjusted as to produce the effect that we have in mind. In brief, in an efficient machine the right materials are properly arranged: in an efficient composition the right words are properly placed. In literature as in practical engineering, then, efficiency is produced by heeding well-established principles; it is liable to be lost by ignoring them. The engineer ignores the principles of composition and produces much that is useless and inefficient; he heeds the principles of engineering, and produces much that is efficient and useful. In short, there is a great disproportion between his engineering and his literary efficiency.

VAPORIZING GOLD IN THE ELECTRIC FURNACE.

Professor Moissan, in vaporizing gold in the electric furnace, finds that 100 to 150 grains can be evaporated in two or three minutes. By condensing the cold vapor on a cool surface, either filiform masses or cubical crystals can be obtained. It is found that gold, like copper and iron, dissolves a certain amount of carbon when in the liquid state, but this separates out as graphite on cooling. Gold is found to be less volatile than copper. The properties of distilled gold are the same as those of hammered gold, or the melted metal reduced to a fine powder. When an alloy of copper and gold is distilled, the vapor of copper comes over first, showing that there is no definite compound. In the case of alloys of gold and tin, the latter metal burns in contact with air. This tin oxide is found to be of a purple color, due to a deposit of fine gold on its surface.—"Mechanical World."

STREET LIGHTING.

J. D. Ross.*

In designing a street lighting system an engineer has to consider, as in every other branch of operating, the system that will give safety, reliability, simplicity and smallest maintenance cost.

The direct-current series arc machine is scarcely to be considered in a new installment. The constant-current transformer or regulator is close to the ideal, but the alternating arc, the power factor of the line, and the powerful inductive effects on phone lines along the streets, make the alternating system inferior to the direct, as far as distribution is concerned.

The ideal system for series work in the present stage of electrical apparatus is evidently one which generates alternating constant current at the station, and after rectifying the current without the use of rotary apparatus, gives direct current for distribution to the arcs. This has been done apparently with success by means of the Cooper-Hewitt rectifier at Portland and other places, and much data is being collected as to efficiency and cost of maintenance. If this system proves a success in these respects it will probably become popular. At the present time the alternating-current system is the most simple and reliable, and has a comparatively small maintenance cost. Constant potential is changed to constant current by varying the leakage lines in a transformer or choke coil, as in the General Electric and Western Electric systems.

The General Electric system is in use in Seattle, lighting 2,950 street corners, or about 350 miles of streets. This system will be doubled as soon as material can be had and the lamps installed. When the city purchased the street system from the Seattle Electric Company the switchboard was eighteen feet long, of the usual plug type, with back primary and secondary circuits at 2,200 and 4,000 volts on the board. To double the system it was necessary to double the capacity of the board, and this extension would take up so much room that the last panel would be outside the building. To avoid this and allow for extensions for several years I designed and installed a board one-eighth of the size, having no voltage on the board higher than 110. The panels were drilled and the switches and instrument transformers were made in the shop at the sub-station.

The system consists, on the primary side, of a two-phase, four-wire, 2,200-volt main with a main switch in each phase. These are electrically controlled from a main panel which also carries the necessary ammeters, wattmeters and voltmeter plug. This main is carried through the building to the places most convenient for the placing of arc transformers, and on the side of each transformer is placed a small double-throw electric control switch operated by solenoids with open-circuit control from a pilot switch on the board. This double-throw switch connects the transformer to either phase to balance the load. The ammeter is of the horizontal edgewise type, and is operated from a 1:1 series transformer placed in the constant current arc circuit.

A small potential transformer is used on each circuit and has a secondary at 110 volts, when all the arcs of the circuit are burning. This secondary leads to the voltmeter receptacle on the board and also to a pilot lamp. As the voltage of a constant current depends on the number of arcs burning on it the voltage at the lamps, and consequently its brilliancy will rise or fall as lamps are added to or taken from the circuit, while an ordinary series pilot lamp would show no change. This lamp will show a partial or total short circuit by dimming or going completely out, while a broken line brings the lamp up far beyond normal brilliancy due to the regulation of the transformer. The controlling panel therefore contains a 6.6 ampere ammeter, a 6 pt. voltmeter receptacle, and two pilot lamps for the two circuits of the transformer and a pilot switch to control the oil primary switch. A small testing panel is placed near the transformer by which the lines may be tested at noon for short circuit, open circuit, or grounds, and which allows of the entire disconnecting or short circuiting of either of the two circuits of the transformer.

For economy of space on the switchboard each ten-inch panel is arranged to hold the equipment for two transformers so that Seattle's street lighting is controlled from a board only ninety-four inches in length, including the twenty-four-inch totalizing panel. In the outside work of arc lighting it is better to use no wire smaller than No. 6 B. & S. for mechanical strength. This, being a high-voltage wire, should be placed on the outside pin of a cross arm. Wiring down the pole, if needed to reach a lamp, should be of duplex wire of standard 3,000-volt insulation, the same as is used for the span from pole to lamp. No knobs should be used for support. The insulation should be equal or better than that of the best quality of railway insulator. If arc and telephone wires must be placed on the same pole the arc wire should be placed seven or ten feet from the phone wire and, being mechanically stronger, should be placed above.

Aside from some form of constant-current service, arc or incandescent, there has been little done in suburban street lighting. The great amount of copper required for a multiple system and the inefficiency of the incandescent lamp have kept the multiple system in the background for street work.

In the business districts, as the area to be lit is proportionately small, efficiency may be sacrificed for some form of lighting that adds beauty and dignity to a street. An even light of moderate intensity is required so that the attractiveness of sign lights and store windows will not be destroyed. The arc lamps have too great an amount of light at a point for even illumination, and the flaming arc is out of the question for any decorative design, as its strong reflections from windows hide all other lights and blinds the eye. It is a well-known fact that the eye tires and the pupil contracts under strong light, making the darkness beyond still darker to the passer-by. It is evident that the most effective lighting system is one using many small sources of light. This fact at once appeals to any one who sees a source of diffused light, such as the Moore Vacuum System.

The incandescent lamp is the nearest approach to the ideal for street work, especially if the glare of the filament is lessened by using a ground-glass or opal ball to diffuse the light. Los Angeles business became alive to the necessity of such a system of lighting, and their system is already famous in illuminating engineering circles. Denver, St. Paul and other cities are installing similar systems. Seattle's business men, on First, Second and Third Avenues, are willing to install such a system if the city will maintain it after installation. The system will be underground, using iron poles carrying incandescent lamps, the height being about fourteen or fifteen feet. Each lamp-post is supplied with switch and cut-out in the base. The underground wires follow the edge of the sidewalk on both sides of the street, and a hand-hole in the sidewalk is used to connect with the pole. I have designed a pole for this purpose, using five lamps in the form of a triangle, all being in the same plane. Each lamp will be covered with a diffusing hood to distribute the light downward and horizontally in the best proportion, the lamp and shade being covered with a ground-glass or opal ball. The lower two are supplied with eight-inch balls, the next two have ten-inch, and the top ball is twelve-inch. Seven of these poles seventy feet apart have already been erected in front of the Franklin Hotel. The light is not intense, but it is easy to read a newspaper anywhere on the street or sidewalk. About five or six amperes will be supplied to each pole, making this system a costly one for current, but, as the incandescent lamp promises to be an efficient illuminant in the future, there is a strong possibility that maintenance cost will be greatly lessened.

*Third lecture delivered by Mr. Ross to the students in Electrical Engineering, University of Washington.

ELECTRIC HEATING AND ITS APPLICATION TO THE FUSION AND FIRING OF REFRACTORY MATERIALS.

By R. S. Hutton, D. SC.*

Quite a large number of industrial processes depend upon the production of high temperature by fuel heating. In many of these cases, in the course of general advance in practice, the limit of temperature aimed at has tended to rise considerably; but it has, unfortunately, seldom been possible to prevent a corresponding decrease in the efficiency of the utilization of the coal.

Those who make it a practice to keep constantly in mind the possibility of the introduction of improvements in such industries as these, cannot fail to have noted the remarkable progress which is being made in the application of electricity for the production of high temperatures.

Serving, at first, solely for the initiation of new industrial processes, demanding temperatures quite beyond the scope of fuel heating, electric heating is already being widely applied in cases where the temperatures required are just within the limit attainable with gas or coal firing, and the general tendency is undoubtedly towards its use for still lower ranges of temperature.

The chief advantages of the application of electricity in this connection may be said to lie, (1) in that it enables the heat to be generated just where it is required—inside, rather than outside, the chamber containing the material to be heated; (2) in the simplicity of a delicate regulation of temperature; (3) in the ease with which the furnace or kiln can be provided with a really efficient heat-insulation, capable of minimizing the thermal losses to the outside air.

Part I.—Laboratory and Experimental Applications.

Just as the metallurgical industry has been able to make far-reaching applications of the investigations on the heat treatment of metals, so, undoubtedly, could the ceramic and allied industries benefit by a thorough and methodical experimental study of the changes in the physical properties of the various oxides and other bodies which enter into the composition of their raw materials, caused by a variation in the temperature at which they have previously been fired.

In all such cases, for laboratory purposes, the use of small furnaces or kilns, in which electric heating is adopted, offers many advantages. Without entering into detail, the following types may be briefly referred to:

(1.) Wire Wound Furnaces—In these the heating is accomplished by an electric current traversing a nickel or platinum wire wound round the tube or chamber to be heated.

For instance, a porcelain tube, which is to serve as the heating chamber, may have a spiral coil of thin nickel wire (suitable for temperatures ranging up to 1,100 degrees or 1,200 degrees coiled tightly on its outside, the tube being then jacketed with a thick layer of some heat-insulating material, preferably stratified.

Furnaces of this type in conjunction with a thermoelectric pyrometer admit of very delicate temperature adjustment; moreover, the nature of the gas atmosphere in which the heating is carried out can be varied at will.

(2.) Carbon Resistance Furnaces—Although, by substituting platinum for nickel wire in the type of furnace previously mentioned, temperatures up to about 1,350 degrees can be safely attained, the cost of platinum is for many purposes prohibitive. For the same reason, the iridium tube furnace of Nernst can scarcely be recommended except in very special cases, although temperatures of some 2,100 degrees can be reached.

Very satisfactory laboratory kilns can be constructed from carbon tubes which become heated by the resistance which they offer to the passage of an electric current. Here, again, the inside of the tube forms the heating chamber, the outside being jacketed with some material, which, in this case, must not only be a good heat insulator, but must also protect the carbon tube from oxidation. Both "carborundum fire sand" and soot have been used for this purpose with some success, and temperatures of over 2,250 degrees have been attained. At these temperatures some form of optical pyrometer, such as that of Wanner or Fery, enables the progress of the heating to be followed with considerable exactitude.

The only disadvantage of this type of furnace lies in the low electrical resistance of the carbon tubes. Currents of several hundred amperes are required, even for the smaller tubes, and with a tube of two and one-half inches internal diameter and two feet length, a current of some 1,000 amperes at ten volts is required to attain 1,900 degrees to 2,000 degrees. When alternating current is available, the installation of these tube furnaces should be possible, even in ordinary laboratories.

A rather different type of carbon-resistance furnace is that in which granular carbon, surrounding the chamber or material to be heated, serves to conduct the current. The granular carbon should be ground, sieved, and graded; the heating being much more uniform if the grains are approximately of the same size. Furnaces of this type have been widely adopted; at the Berlin Porcelain Works they have been used up to about 1,700 degrees. For really high-temperature work, however, their application is limited by the impossibility of finding a suitable refractory material of which to construct the walls of the heated chamber.

(3.) Electric Arc Furnaces—Where the very highest temperatures are required, the use of the electric arc offers many advantages. It is much easier, as a rule, to concentrate the expenditure of a large amount of power in an arc than in an ordinary resistance, and consequently the rate of heating and the limit of temperature attained is in this case frequently superior.

The arc may be open, and the heat radiated from it be thrown downwards upon the material under investigation, as in the well-known furnace used by Professor Henri Moissan, or the arc may be directly surrounded by the substance to be heated, and thus smothered. In the latter case the heat can obviously be more economically employed.

Part II.—Industrial Processes.

In the following brief notes the chief materials to be described are carborundum, graphite, alumina, magnesia and silica; and, since many detailed accounts of some of these industries have already appeared, it is intended chiefly to deal with the recent progress which has been made.

Carborundum—The manufacture of carborundum, which is carried out at Niagara Falls, has increased steadily until now it may be considered quite an important industry.

The process consists essentially in heating a mixture of sand and coke to a high temperature. The mixture completely surrounds a central heating core of coke through which a powerful electric current is passed, the charge being kept in place by temporary walls of fire-brick. Some 5,000 horsepower is at present employed in this industry; the individual furnaces, for the most part, consume 1,000 horsepower, and each furnace is continuously run for about thirty-six hours; after which the current is switched off, and a fresh furnace started. Recently a batch of 2,000-horsepower furnaces have been installed. The output of a 1,000-horsepower furnace in thirty-six hours is about 3.15 tons (metric) of crystalline carborundum; whereas the total production of this substance in 1904 was about 3,152 tons. Although most of the crystalline carborundum is used as an abrasive, considerable quantities of "amorphous carborundum" and "siloxicon," which are both products formed at a lower temperature in a

*Abstract from an article contained in the Transactions of the English Ceramic Society.

similar type of furnace, are coming largely into use as refractory materials.

At the present time a large factory is being equipped at Niagara for the manufacture of bricks, crucibles, etc., made of "siloxicon." Much attention has been given of late to the problem of agglomerating the powdered carborundum with a view to making strong vessels of this material. Among other similar uses, the lining of kilns with bricks coated with a thin layer of carborundum may be mentioned.

Artificial Graphite—This industry, like that of carborundum, owes its development on a large scale to the inventive genius of E. G. Acheson. The process consists in the electrothermic transformation of amorphous carbon into graphite The carbon in the form of bars and rods, produced by a similar method to that employed for making carbon electrodes for arc lamps, is heated to a high temperature in a resistance furnace, very similar in type to that employed in the manufacture of carborundum, and during this heating is completely transformed into graphite. The product has been employed chiefly in the electrical industry, but recently the process has been extended, and the graphitization of lumps of anthracite coal and coke is now carried out. The resulting material is displacing natural graphite in many of its varied uses. In 1904 some 1,450 tons (metric) of artificial graphite were produced, 1,000 horsepower being continuously employed. The plant has now been duplicated owing to the increasing demand.

Fused Alumina—From quite early times investigations of the effect of high temperatures upon alumina have been carried out. The object of this work, in the first place, was the production of artificial rubies. After much painstaking work, in which other French scientists have taken part, Verneuil has succeeded in producing fairly large masses, and has recently described his most ingenious method of working.

The first extensive application of fused alumina must, however, be ascribed to the Norton Emery Wheel Company, who have for long been well known as manufacturers of abrasive articles of natural corundum, and who acquired an electric furnace process of fusing bauxite, and installed a plant at Niagara Falls. Their product is put on the market under the name of "alundum," to distinguish it from natural corundum. This process, started in 1901, has proved quite successful, the output in 1904 being 1,800 tons, practically all of which was used in the manufacture of grinding wheels and other abrasive articles. The fused product is characterized by its toughness and hardness, and is said to possess superior qualities to those of the natural material.

At Rheinfelden a similar product is being manufactured, but is called "diamantin"; the Goldschmidt "thermit" companies are also employing as an abrasive the fused alumina which occurs as a by-product of the processes which they carry out.

Of more direct interest is the application of fused alumina to the production of a new "pottery body." This development has been carried out by an important German firm of potters (Deutsche Steinzeugwaarenfabrik, of Friedrichsfeld) in conjunction with a leading chemical works. Articles made from this new material are said to possess to a remarkable degree the power of withstanding sudden heating to a high temperature. This is due to the very small contraction which occurs in articles made with suitable mixtures of the fused alumina and clay.

It would indeed be of interest to know the relative behavior of other completely "shrunk" oxides, etc., when used in a similar manner; by actual fusion in the electric furnace these materials can be obtained in a condition in which subsequent heating causes no further contraction. The strength of bodies made of such materials, when subjected to severe thermal treatment, probably depends much more upon the completeness of this "shrinking" that upon the thermal conductivity.

Magnesia—Since magnesia is the most refractory of the commonly-occurring oxides, it is surprising that it is not more widely employed for the construction of vessels capable of withstanding high temperatures. Up to the present, however, ordinary calcined magnesia has been found none too well suited for this purpose. Magnesia bricks, crucibles, etc., of nearly all makes, require very great care in handling, and it is particularly necessary in furnace work to heat them evenly and slowly, otherwise fracture occurs.

Recently the electric furnace has been used to fuse or shrink magnesia, and much may be expected by the application of such products for the manufacture of crucibles, etc.

Pure magnesia tubes and other vessels of small size are now made by the Royal Porcelain Factory at Berlin, but, on account of their high cost, are obviously of greater importance for scientific than for technical work. There is, however, nothing to hinder the cheap production of electrically shrunk magnesia on a large scale, so that further developments along these lines may confidently be expected.

Arc furnaces, very similar in general type to those employed in the manufacture of calcium carbide, have been used technically for the production of fused alumina and magnesia, and, where it is desirable to produce a really fused and liquid product, there are somewhat great difficulties in the way of using a resistance furnace with material packed around a central core. On the other hand, much can be done with resistance furnaces, and large masses of magnesia can be heated to near the melting point, and caused to recrystalize, with a very simple type of furnace, and with considerably lower power expenditure than is incurred with the arc type of furnace.

Silica Glass—The fusion of quartz has, within the last few years, shown signs of developing into a flourishing little industry.

Recently the electric furnace has been called into service with most satisfactory results. Relatively large tubes have been obtained from quartz crystal or Calais sand, both by indirect heating with the electric arc and also by passing the electric current through a carbon core surrounded by sand. Recently the electrical process has been developed, and a method discovered for blowing and shaping vessels from the semi-fluid material, produced around an electrically-heated core. With these and other improvements, the Thermal Syndicate, of Wallsend-on-Tyne, is producing large pipes, bricks, dishes, insulators, pyrometer tubes, and a variety of other ceramic articles.

The fused silica has most valuable properties; not only can it withstand extreme and sudden changes of temperature, but its highly refractory nature and extreme hardness should also assure it numerous applications in the chemical and other industries.

On account of the inclusion of small air bubbles in the plastic mass, and the impossibility of bringing silica into a really fluid condition, up to the present time a perfectly transparent material has not been obtained in large masses. The translucent nature of the product will, however, enable it to be used for many purposes in addition to those mentioned above.

Oakland, Cal.—The Southern Pacific Co. has been quietly making arrangements for the extension of its Webster Street line out Franklin Street from Fourteenth to Twentieth Street, at which point it will deflect westward from San Pablo Avenue and connect with its line in West Oakland, thus making a loop through the center of the city and connecting both moles of the company. The construction of the new line will make the Southern Pacific a formidable rival for a large volume of passenger business that the Key Route has been zealously striving to secure. The company officials say that the work on the new electric line, or rather the changing of the present steam lines to electric power, will be pushed forward as rapidly as possible, and that the change in the system, together with the rolling stock under the contracts, will cost nearly $2,000,000.

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EDITORIAL.

The Determination of the Average and Maximum Power Demand.

Probably the most important point involved in the distribution and disposition of electrical energy is the determination of the cost per unit of consumption, or per kilowatt-hour as affected by the character of the demand during each twenty-four hour period. For any given quantity of energy used during each month it is possible that the cost of producing and delivering to the customer and therefore the selling price may be increased or diminished through a very wide range, depending solely on the average and maximum use during the month. The cost of power naturally varies with the cost of fuel or the cost of generation and transmission to the point of consumption, but the so-called "load factor" is undoubtedly to be given the most careful investigation after the other factors have all been accurately determined.

Innumerable efforts have been suggested and some fairly satisfactory schemes put into operation, to commercially establish the relation of the maximum demand and the average use. The very compact and reliable integrating wattmeter is an exceedingly satisfactory instrument to measure the total kilowatt-hour use during any period and from the total energy the average demand may be found by dividing the kilowatt-hours by the total number of hours during which power has been used. The difficulty, however, is to ascertain within a reasonable range of error, not only what the maximum demand for power is, but also to get a record of the length of time during which the maximum load continues.

The ordinary recording electrical instruments with twenty-four-hour charts cannot be depended upon for anything more than approximate readings, or rather, indications. Not only must the charts be renewed daily but large and sudden variations of load tend to seriously impair the accuracy of the instrument. Continuous recording instruments have been introduced more especially for indicating the load in kilowatts, but the amount of care and attention they require, coupled with the serious effects which may result from sudden changes in load, excludes them from use in many instances. All types of recording instruments are open to the objection that the momentary swing of the needle, or recording device, exaggerates the fluctuation, and the record therefore indicates a larger load than actually occurs when the load is suddenly increased, and, similarly, a smaller load is recorded than the actual minimum, in case of a sudden reduction in the demand.

Maximum demand ampere indicators that operate as a result of the heating effect of the current are free from this objection; in fact, in most types, very short or sudden increases of load do not affect the instrument at all. The construction of the maximum demand ampere indicators is very simple, and they can be depended upon, in most cases, to give good commercial results. They are, however, open to the objection that they do not indicate the maximum power, but only the maximum current, which, with alternating current, is not proportional to the power, except at unity power factor and constant voltage. Even when used with direct currents or alternating currents at high power factors it is important to also get records of the voltage at times of greatest load. The fact that the maximum ampere demand meters are made slow acting or sluggish, to a great extent offsets the objection that they are ampere indicators, rather than power-measuring devices, particularly when used on alternating current circuits, where the starting of induction motors causes temporary and very short current demands at low power factor.

A CORRECTION.

In our issue of December 29th we published in the department of the "Journal" devoted to Industrials, a short article, headed "Some Recent Western Sales of the Allis-Chalmers Company," and in this article conveyed the impression, unintentionally, that the Edison Electric Company, of Los Angeles, had installed at Caliente, on the Kern River, five 3,200-kilowatt Allis-Chalmers alternating-current generators.

Since that time both the General Electric Company and the Allis-Chalmers Company have written us that this statement was a mistake, and requested a correction. As a matter of fact, the Allis-Chalmers Company did supply five generators as noted above for a plant at Caliente, but this plant is not controlled by the Edison Electric Company.

Whenever the "Journal" inadvertently publishes a statement which is not authentic, we wish, in justice to all concerned, to make all possible reparation, by publishing the facts only.

BOOK REVIEW.

The Pacific Coast Gas Association has just published in very attractive form the papers entitled "The Compression and Transmission of Illuminating Gas" and "Some Economics in High-pressure Gas Transmission," by Edward A. Rix. These were read at the meetings of the association of 1905 and 1906. Illustrated with charts and tables, it forms a valuable authority on the transmission of illuminating gas.

TRADE CATALOGUES.

General Electric Co. Bulletins—

No. 4485—A portable gasoline engine and generator outfit. The engine is of a four-cycle, four-cylinder, six-inch diameter by six-inch stroke, water-cooled type. The generator direct connected thereto is of the revolving-field type with a range of alternating current for 32, 55 and 110 volts. The complete set is mounted on a common base, which is in turn bolted to skids so that it may be carried on a truck, or as a sled.

No. 4487—A small-plant, continuous-current switchboard. This is a standard type, and is suitable for small continuous-current isolated plants.

No. 4488—Thompson Recording Wattmeter. This supersedes Bulletin No. 4415.

No. 4489—Crane wiring supplies. This shows equipment for installing crane motors.

No. 4490—Is devoted to the description of a portable air compressor set.

No. 4491—Superseding Bulletin No. 4369. Describes the R-84-C Controller, adapted to power and mining service.

No. 4492—Small-plant, alternating-current switchboards for three-phase, small lighting systems.

RATING OF RAILWAY MOTORS.

The question of determining whether a better form of rating of railway motors can be prepared than that now used is now occupying the attention of the standardization committee of the A. I. E. E., and in the meetings of the committee there has been a spirited interchange of opinions on this subject by representative railway motor men.

In connection with this discussion the "Street Railway Journal" comments as follows:

"The present method of designating railway motors, the so-called 'commercial rating,' consists in fixing the horsepower output of the motor which will raise the temperature of the hottest part seventy-five degrees C. after a stand test of one hour with covers removed. This rating of railway motors has been handed down from the early days of elecrtic railroading, and its strongest advocates have urged its continuance only on the ground of its serving the purpose of an excellent commercial test of both the electrical and mechanical qualities of the motor. They admit that the one-hour rating is not a definite indication of the fitness of a motor for a given service, nor is it a true comparison between motors of different capacities, but they claim that it does have the advantage of expressing in a single simple term an approximate comparison of the electrical and mechanical qualities of motors of different capacities.

Owing to the complicated nature of the calculations involving the selection of a railway motor and the different methods in use by the different manufacturing companies and outside engineers in arriving at its selection, the time may not yet be ripe to settle upon any one method of railway motor determination. To complicate the matter still further, any expression indicating the true service capacity of a motor can probably not be reduced to a single term, but must be put in the form of several terms, or, better still, in curve form. As a method of "rating" railway motors a curve would seem impossible, although it would be extremely useful as indicating the service capacity of the motor. It seems a very wise suggestion, therefore, to continue the one-hour rating of railway motors and not to demand at the present time any universal adoption of the several service determinations offered, owing to the very apparent lack of agreement among authorities. At the same time, and to compensate consulting engineers for the non-adoption of a more satisfactory service rating of railway motors it appears proper to include under the head of "desirable information to be furnished," such data in regard to thermal capacity of the motors, core losses, copper losses, and other internal losses, together with continuous current carrying capacity at different voltages with seventy-five degrees rise, and such other data as would enable a consulting engineer to make as many service calculations as he may desire.

At present the selection of railway motors rests largely in the hands of the manufacturers, a decision which has been rather forced upon them, owing partly to their desire to insure satisfactory service operation of their apparatus and partly owing to the unpreparedness of the outside engineering profession to act in this matter. The determination of the service capacity of a railway motor is a matter involving elaborate tests and considerable expense, and it is proper that such tests should be made by the manufacturer. There seems to be no reason, however, why results of these tests should not be more widely distributed so as to be available to the consulting engineer who may have the experience and inclination to apply the experimental thermal characteristics of the various motors to a concrete problem. The consulting engineer, if thoroughly informed of the requirements of a projected road, and having the thermal characteristics of the various motors as determined by the manufacturers, can then make fully as intelligent a selection as the latter, provided he is willing to give the time necessary for perhaps rather long and tedious calculations. It makes little difference to the consulting engineer whether this additional information about railway motors is presented in the form of a "rating" or not. The main point is to ventilate more widely the conditions governing the operation of railway motors and to be in possession of sufficient test data to simplify the solution of this very perplexing question.

THE INSTITUTION.

The announcement which we make in another column that Lord Kelvin has accepted nomination for the office of President of the Institution of Electrical Engineers for the session of 1907-8, will be read with much satisfaction by all sections of the electrical engineering community. That such signal honor should be conferred upon our Institution by the doyen of electrical science in this country, who has already occupied the presidential chair on two occasions, is a matter for congratulation, and it shows how closely Lord Kelvin keeps in touch with electrical engineering progress on the practical as well as on the theoretical side. It was in 1874 that Lord Kelvin was elected for the first time, and in 1889 he was again elected. During the current session he is acting as president of the Glasgow Local Section, and has evinced much interest in the affairs of the local branch—notably on the occasion of the visit of the representatives of foreign electrical societies to Glasgow last summer. We have no doubt that Lord Kelvin's acceptance of the presidency of the parent Institution for the third time will stimulate the interest of its members and add to its usefulness.

Spokane, Wash.—Extensive changes in the system of the P. S. Tel. & Tel. Co. are under way. The principal change is the installing the central energy system.

INDUSTRIAL

COMPARISON OF VARIABLE SPEED SYSTEMS.*

In making a comparison of the merits of the systems most commonly used there are two points to carefully consider. The size and weight of a motor is dependent to a great extent on the minimum speed at which the motor is required to develop its full rated power, and the slower the minimum speed the greater will be the size and weight for a given horsepower output. As a gear or chain drive is used on motors operating machine tools, the maximum speed of the motor is dependent on the peripheral speed of the motor pinion, or upon the maximum ratio of speed reduction between the driven shaft and the motor shaft. This limits the maximum speed of motor to 1,000 to 1,600 revolutions per minute, depending upon the output of the motor.

In order to show clearly the performance of a motor on

ALLIS-CHALMERS TYPE "K" MOTOR—OPEN STYLE.

power developed by a motor which has a rating of 10-horsepower, 240 volts, 600 revolutions per minute, when operated at constant speed and continuous service. This motor will stand a current overload of 40 per cent. for intermittent service, such as machine tool duty, without undue heating or sparking when operated at full field strength, and will therefore be rated at 14-horsepower, 240 volts, 600 revolutions per minute intermittent duty. The speed can be increased from 600 to 1,200 revolutions per minute and the motor rated at 10-horsepower at the high speed without sparking at the brushes. For the intermediate speeds between 600 and 1,200 revolutions per minute the rating of the motor will gradually decrease from 14-horsepower to 10-horsepower as the motor speed is increased. For horsepower ratings at lower voltages the current overload with full field strength will be the various systems, a comparison will be made with the the same as for 240 volts, and this will decrease as the speed is increased by weakening the fields.

Assume that the motor will be used on a 30-inch engine lathe and the gearing changed to suit the particular requirements of the system on which the motor is to be operated. A standard armature will be used on the three-wire and four-wire systems and a special armature on the two-wire. The swing-over carriage will be 20 inches, swing-over shears, 30 inches, and the power and speed requirements of the lathe as follows:

The minimum speed of the lathe should give a cutting speed of 30 feet per minute on the maximum diameter. This will be 4 revolutions per minute. The maximum speed of lathe should give a polishing speed of 200 feet per minute on 2½-inch diameter. This will be 320 revolutions per minute. The total speed range will, therefore, be 80:1, or from 320 revolutions per minute to 4 revolutions per minute.

As this lathe will swing but 20 inches over the carriage, the maximum power will be required on diameters of work less than 20 inches, say, from 19 inches to 3.8 inches, between which sizes the lathe will be required to turn steel, the size of cut being ¼ inch by 1/16 inch at 80 feet per minute. This will require 8 horsepower on spindle speeds between 16 revolutions per minute and 80 revolutions per minute. On diameters below 3.8 inches the size of cut will gradually decrease, and this will cause a corresponding de-

*Courtesy of the Allis-Chalmers Company.

crease in the power required by the lathe. At the minimum speed of 4 revolutions per minute a cut of ¼ by 1/16 at 30 feet per minute on cast iron will require 2 horsepower.

From 4 revolutions per minute to 16 revolutions per minute the power required by a lathe will increase with speed from 2 horsepower to 8 horsepower. From 16 revolutions per minute to 80 revolutions per minute the power will be constant at 8 horsepower. From 80 revolutions per minute to 320 revolutions per minute the power will gradually decrease to 5 horsepower.

Two-wire Single-voltage System.

Speed of Motor, 440 to 1,200 Revolutions Per Minute.—Four Runs of Gearings.

Motor		Third Back Gear		Second Back Gear		First Back Gear		Direct	
Speed	H. P.	Speed	H. P.	Speed	H. P.	Speed	H. P.	Speed	H. P.
440	10.2	4	2	12.4	6	38.4	8	116	7.2
520	10	4.7	2.3	14.6	7.3	45	8	136	6.9
600	9.8	5.4	2.7	17	8	52	8	153	6.6
690	9.3	6.4	3.2	20	8	61	8	185	6.3
800	8.8	7.3	3.7	22.6	8	70	8	214	6
920	8.4	8.4	4.2	26	8	80	8	245	5.7
1050	8	9.5	4.8	29.5	8	91	7.8	280	5.4
1250	7.5	11	5.5	34	8	105	7.5	320	5

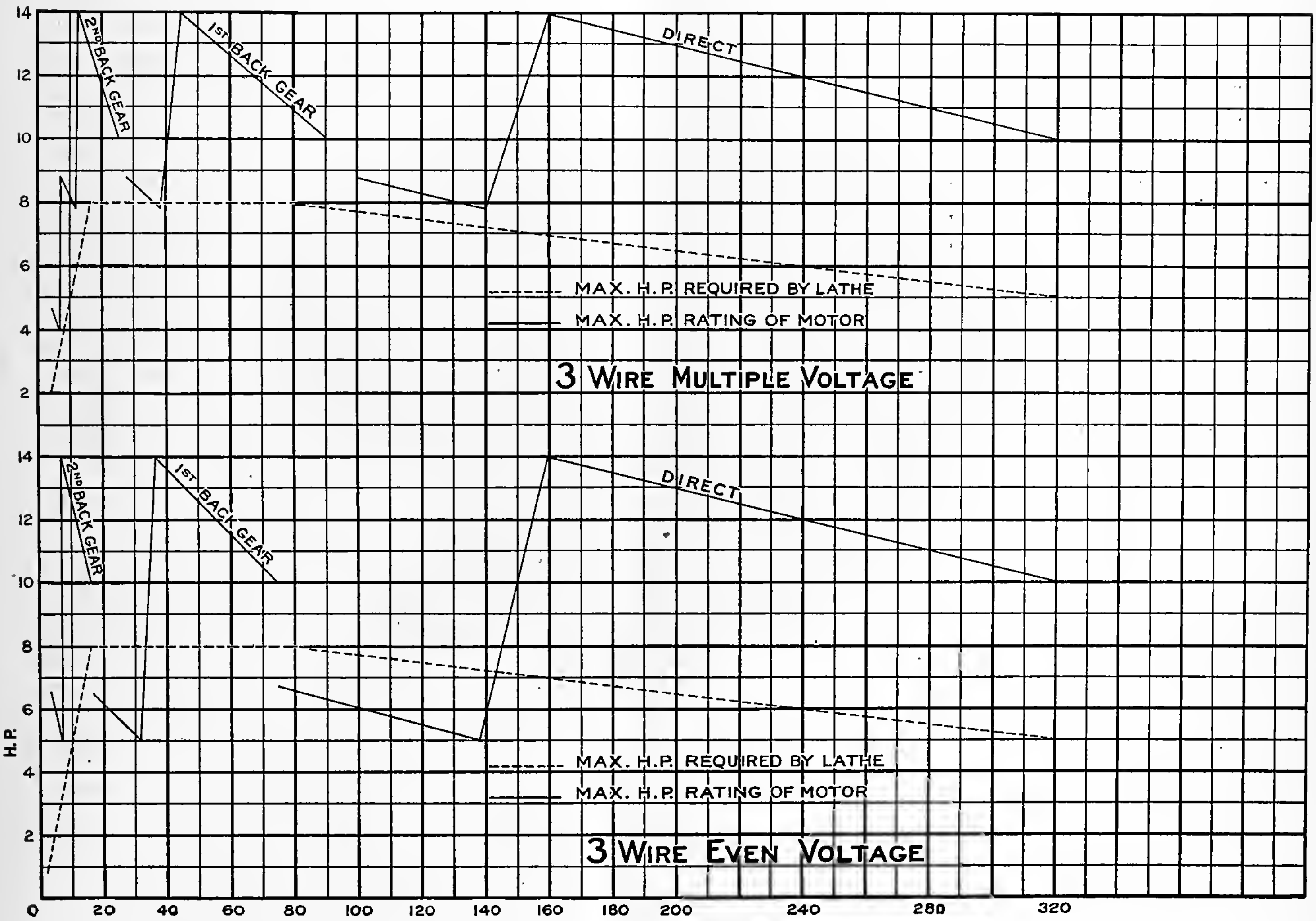

FIGURE 1.

There is only one point in the speed range where the power of the motor is less than that required by the lathe, namely 34 revolutions per minute, where the required power of lathe is 8 horsepower and motor is 7½ horsepower. This motor requires, however, four runs of gearing, which is more complicated and expensive than is required by the other systems which have only three runs of gearing.

Three-wire Even Voltage.

Speed of Motor, 280 to 1,200 Revolutions per Minute. Three Runs of Gearing.

Motor		Second Back Gear		First Back Gear		Direct	
Speed	H. P.	Speed	H. P.	Speed	H. P.	Speed	H. P.
280	6.5	4	2	17.2	8	75	8
325	6	4.65	2.3	20	8	87	7.8
375	5.6	5.35	2.7	23	8	100	7.5
450	5.3	6.45	3.2	27.9	8	119	7.2
520	5	7.35	3.6	31.7	8	138	6.9
600	14	8.55	4.3	37	8	160	6.6
690	13	9.85	4.9	42.5	8	185	6.3
800	12	11.4	5.7	49	8	214	6
920	11	13.1	6.6	56.3	8	245	5.7
1050	10.5	15	7.3	64	8	280	5.4
1200	10	17.1	8	73.5	8	320	5.

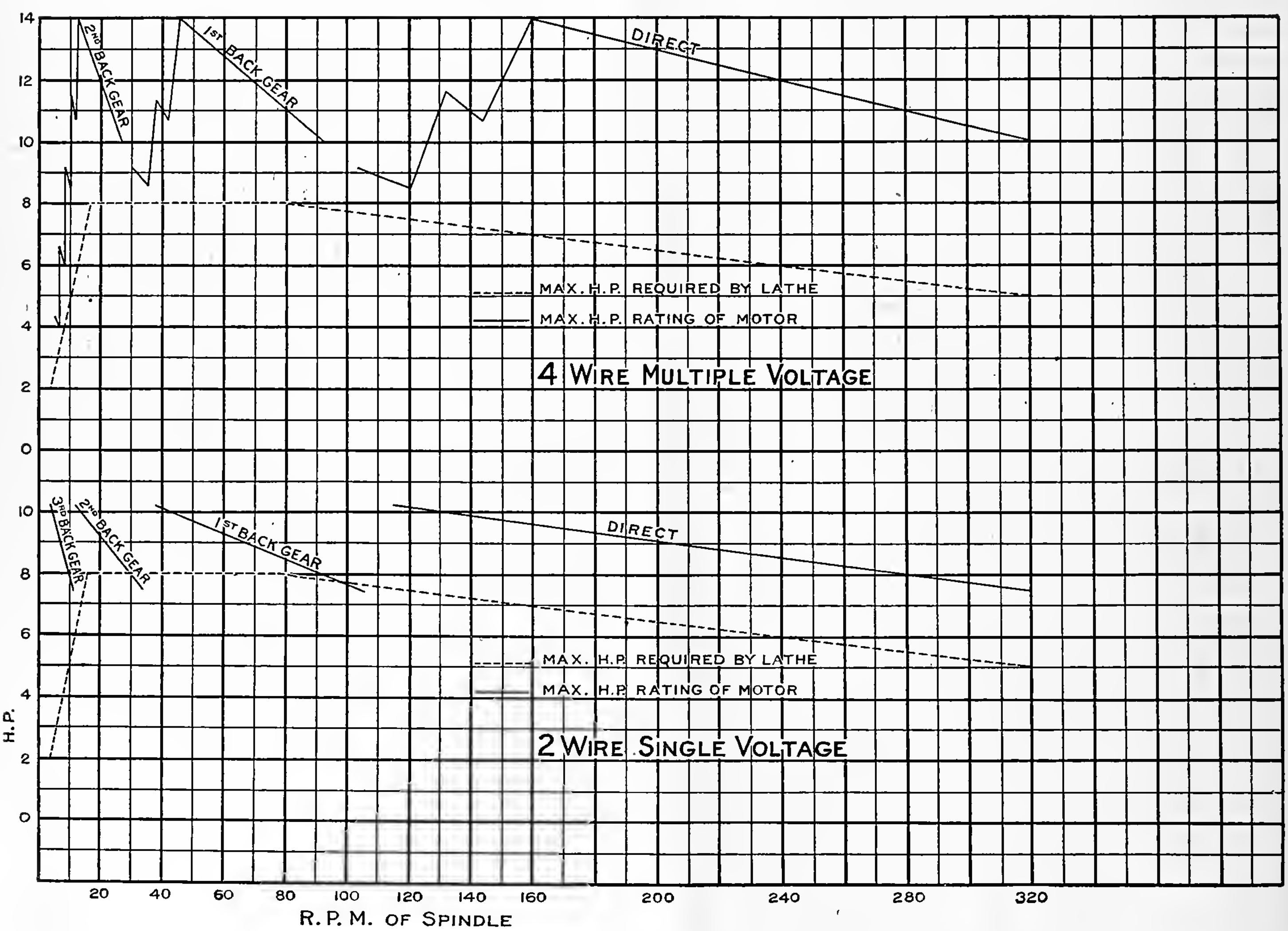

FIGURE 2.

With this system the motor will develop from 6.5 horsepower to 5 horsepower between the ranges in spindle speed 17.2 and 31.7 and from 75 to 138 revolutions per minute. The power required by the lathe for these spindle speeds is 8 horsepower. In order to obtain the required power by the three-wire even voltage the size of motor must be increased 60 per cent. There would, furthermore, be no advantage in using a lesser speed range and a greater number of runs of gearing, unless the speed range were decreased 2:1, in which case the motor would be operated on a two-wire system instead of on a three-wire even voltage.

Three-wire Unequal Voltage.

Total Range of lowest Run of Gearing, 194 to 1,200 Revolutions per Minute. Partial Range on Other Runs, 375 to 1,200 Revolutions per Minute. Three Runs of Gearing.

Motor		Second Back Gear		First Back Gear		Direct	
Speed	H. P.	Speed	H. P.	Speed	H. P.	Speed	H. P.
194	4.6	4	2				
225	4.4	4.64	2.3				
280	4.2	5.77	2.9				
325	4	6.7	3.4				
375	8.75	7.22	3.6	28	8	100	7.5
450	8.3	9.28	4.6	34	8	119	7.2
520	7.8	10.7	5.4	39	8	139	6.9
600	14	12.4	6.2	45	8	160	6.6
690	13	14.2	7.1	51.5	8	185	6.3
800	12	16.5	8	60	8	214	6
920	11	19	8	69	8	245	5.7
1050	10.5	21.7	8	78.5	8	280	5.4
1200	10	24.7	8	90	7.8	320	5

There is only one point in speed range where the capacity of the motor is less than that required by lathe, namely, 39 revolutions per minute. At this point the capacity of the motor is 7.8 horsepower and the power required by the lathe is 8 horsepower.

Four-wire Multiple Voltage.

Total Range on Lowest Run of Gearing, 180 to 1,200 Revolutions per Minute. Partial Range on Other Runs, 390 to 1,200 Revolutions per Minute, Three Runs of Gearing.

Motor		Second Back Gear		First Back Gear		Direct	
Speed	H. P.	Speed	H. P.	Speed	H. P.	Speed	H. P.
180	4.25	4	2				
225	4	5	2.5				
280	6.5	6.22	3.1				
325	6	7.22	3.6				
390	9.1	8.68	4.3	30	8	104	7.5
450	8.5	10	5	34.6	8	120	7.2
495	11.5	11	5.5	38	8	132	7
540	10.7	12	6	41.5	8	144	6.8
600	14	13.3	6.7	46.2	8	160	6.6
690	13	15.3	7.7	53	8	185	6.3
800	12	17.8	8	61.5	8	214	6
920	11	20.5	8	70.8	8	245	5.7
1050	10.5	23.3	8	81	8	280	5.4
1200	10	26.7	8	92.5	7.8	320	5

In this system the motor has sufficient capacity at all points in the speed range. The increase in capacity, is, however, not sufficient to warrant the use of this system instead of the three-wire unequal voltage, on account of additional expense.

One of the most important features of our system is that it lends itself admirably to existing installations. Any motors can be run on this system without any change whatever, it being only necessary to supply the system with two or more different voltages and add the required controllers. In manufacturing plants where tools are installed that are supplied with mechanical speed-changing devices, constant-speed shunt motors may be used and run on the outside wires of the multiple voltage system. The motors used for this kind of service should, however, meet with certain requirements, and for this purpose the Allis-Chalmers direct-current motors are especially adapted.

Mr. William H. P. Hill, general manager of the Monterey County Gas & Electric Company, has secured the services of Mr. Frederick S. Mills as general superintendent, and Mr. Frederic Southerland as assistant superintendent.

Mr. Mills was, until recently, connected with the General Electric Company, as a traveling agent for machinery.

Mr. Southerland, a former Cornell man, has been on the Coast only a few months, coming from the New York Edison Company, in New York City.

The Monterey and Pacific Grove Railway, controlled by the Monterey County Gas & Electric Company, will soon commence the work of rebuilding the road, and a greatly improved service is confidently expected.

The M. C. G. & E. Co. has just placed an order with the General Electric Company for two 500-kilowatt Curtis turbo-generators, and the Charles C. Moore Company has been given the contract for boilers. This equipment, when completed, will make the Monterey plant one of the most up-to-date installations on the Coast, and arrangements have been made for more units as required.

NEWS NOTES

TRANSPORTATION.

Monterey, Mexico.—Chinese residents of Torreon, headed by Foon Chuch and Dr. J. W. Limm, have secured a concession to build an electric railroad beginning at New Torreon, where they have large holdings. They will spend $200,000.

San Diego, Cal.—The city is advertising for bids for a franchise for the construction of a street railway from Winler and India Streets to the water front at Ocean Beach. The bids will be opened on April 1st and the franchise will then be awarded.

Porterville, Cal.—At a meeting of the Board of Trustees last week an application for a permit to lay tracks and string wire in the streets of Porterville was presented. The permission was sought by the Sierra Pacific Railroad Company. The promoters expect to build in a short time.

San Diego, Cal.—Notification that the work on the Adams Street car line, which will be built eastward from the Pavilion through Normal Heights by the San Diego Electric Railway, will be commenced immediately was received last week by D. C. Collier, president of the Ralston Realty Company.

Long Beach, Cal.—George W. Hughes, president of the Signal Hill Improvement Club, is at the head of a syndicate which intends to furnish rapid transit from Long Beach to the summit of the hill. Some time ago a petition was filed with the City Trustees asking for a franchise for tracks along certain streets of the city and running northeast to the top of Signal Hill.

Los Angeles, Cal.—Three franchises for the extensions of proposed electric lines have been sold by the Board of Supervisors to the Los Angeles Pacific Co. for $100 a piece. The roads run to Irwindale and Hollywood. An application from the Pacific Electric Co. for the extension of its Temple Street line beyond the city limits was referred to the district attorney.

San Diego, Cal.—At the special meeting held February 26th the street committee of the City council recommended an ordinance granting a franchise to H. W. Keller and W. C. Kerckhoff, of Los Angeles, for an electric railway from H Street, in this city, north to Del Mar. There must be $50,000 worth of construction work done each six months from the time construction begins.

Nevada City, Cal.—John Martin, promoter of the California Midland Railroad, has been here, accompanied by his chief engineer, Chas. Trow. They are looking over the local situation and completing deals for rights-of-way, several of which have already been paid for. They plan to connect with the local interurban line to Grass Valley, and have certain pieces of property under bond for a terminal site.

Oakland, Cal.—F. M. Greenwood, who obtained a franchise a year ago from the Board of Trustees of the City of Alameda to build and operate an electric railway through that city in connection with a ferry service to San Francisco, has organized a company for that purpose, under the name of the San Francisco, Alameda and Eastern Railway Co. The company has a capital of $2,000,000. The directors are F. M. Greenwood, A. D. Schwindler, A. H. McHuron, W. H. Spald-

Los Angeles, Cal.—The Ontario and San Antonio Heights Railway Company, owned and controlled by the Pacific Light and Power Company of this place, has commenced work on its new extension across San Antonio Heights to a park of 200 acres just west of Mountain Avenue. Manager Burt has planned many attractions at the new park, and a tourist hotel is being planned in the vicinity.

Los Angeles, Cal.—A contract has been awarded by the Los Angeles Interurban Railway Company to R. Shere & Company to complete all grading and other work for the roadbed of the double-track railway known as the Monrovia-Glendale line. The consideration is to be 18 cents per cubic yard for earth excavation, 40 cents per cubic yard for loose and hard-pan excavation, 75 cents for solid rock and 18 cents for embankment.

Alameda, Cal.—Oliver Ellsworth, representing F. M. Greenwood, who was granted a franchise some time ago to construct an electric road on Clement Avenue to connect with the proposed ferry system to San Francisco, notified the City Clerk that Greenwood was prepared to place in escrow the required $50,000 guarantee that he will carry out the terms of the franchise, but at the appointed time the money was not forthcoming.

Los Angeles, Cal.—An ordinance has been adopted giving W. C. Weaver the right to construct and operate a double-track railroad upon certain public streets in Los Angeles. The proposed line is to run from the corner of Piedmont and Pasadena Avenues along Pasadena to New York Street and along this to the western boundary of the city. A branch is to commence at New York and Latrobe and run along the latter to Eagle Rock Avenue and along this to the city limits.

San Jose, Cal.—L. E. Hanchett of the San Jose-Santa Clara Railroad Company has been granted franchises for which he petitioned the Mayor and Council. The entire system will be made broad gauge, and the new cars to run on it will be bought at a cost of $14,000 each. Altogether the work is expected to cost over $1,000,000. New lines are to be built on Third, Fifth, Eighth and Jackson Streets, from Antonio Street to Second. The management of the entire system will be in the hands of C. C. Benson.

Long Beach, Cal.—H. C. Oakley of Los Angeles, the agent who has secured the right of way for the proposed four-track railroad between Los Angeles and Long Beach, by way of Gardena, has gone further and secured valuable sites on the flats west and northwest of here. The property could be useful as a terminal site for an overland railway, and W. B. Redburn has said that there is no doubt that the property was secured for a transcontinental line seeking access to Long Beach harbor.

Stockton, Cal.—The application of the Central California Traction Company for a franchise to carry freight over its lines to this city, as presented to the Council recently, disclosed the fact that the company is projecting 175 miles of road in this county, to connect with other roads in other counties. The motive power will be electricity. The application set forth the fact that there will be a line from Sacramento to Lodi, thence to Stockton, and one to Modesto, a distance of 90 miles. A branch line will be run from Lodi to Walnut Grove.

Sacramento, Cal.—It is announced that the Sacramento Electric, Gas and Railway Company has placed an order for fourteen additional street cars, modern in every respect, to be used on the lines of this city. General Manager Fitzpatrick is authority for the statement that the company proposes to keep abreast with the growth of the city and that service will be made seven and a half minutes on several

lines where it is now ten minutes. The change will be made as soon as the new cars are delivered.

San Francisco, Cal.—A street car strike is expected by Mayor Schmitz, as is witnessed by the following passage from a letter sent to Police Commissioner Cresswell: "I received information a few days ago to the effect that on May 1st another car strike would take place. Of course, I intend to avert it if possible. If a strike does take place—and from all accounts it seems almost unavoidable—your position naturally would be inconsistent as a member of the Police Commission. I therefore think it advisable to accept your resignation, which was forwarded to me some time ago."

Pasadena, Cal.—The most important announcement concerning the changing of the local street care system which has been made since the agitation for less congested traffic commenced, came this week from Jas. B. Rowray, superintendent of the northern division of the Pacific Electric. He goes on record as favoring the loop system. His utterances are guarded, but they imply that he believes that the loop plan, as outlined by several business men, will fill the bill, and when Huntington returns in the Spring he will dispose of the question.

San Francisco, Cal.—The United Railroads will begin service on the Sacramento Street line from Fillmore to the ferry before long. While a large gang of men is working on the western end of the line another force will soon be put to work completing the loop at the ferry, which will give safer service to patrons than the old curve at Sacramento and East Streets. After leaving Fillmore Street the cars will go down Sacramento to Larkin and thence over Larkin to Clay, and down Clay to the water front. The tracks will run along East Street until they come to the gore at Sacramento and Market, where they will join the western curve of the Market Street loop for a few feet. They will then round the gore and branch off up Sacramento to Fillmore. In this way the Sacramento Street cars and those rounding the Market Street loop will be going in the same direction at a safe distance from the Market Street curb.

INCORPORATIONS.

San Francisco, Cal.—A certificate of diminution of stock has been filed by the Central Light and Power Co.

Seattle, Wash.—The Globe Electric Co., capital $25,000, has been incorporated by J. A. Reardon, A. C. Weaver, Frank Becker and P. J. Knight.

Oakland, Cal.—With a capital stock of $200,000 the Borein Water Co. has been incorporated. L. H. Bell, C. A. Borein and C. C. Hamilton are backing the project.

Antioch, Cal.—An assessment has been declared by the Antioch Oil Co. of one and one-half per cent per share, delinquent March 16th, sale day March 16th.

St. Anthony, Ida.—The Peaceful Valley Imp. Co., Ltd., has been granted a fifty-year franchise for the erection of a power line in Fremont County.

Santa Barbara, Cal.—The Santa Maria Oil and Transportation Co. has been incorporated here with a capital stock of $1,000,000, of which $3,500 has been subscribed.

Napa, Cal.—H. M. Pitman, T. B. Pitman, and G. S. Cutler have incorporated the Napa Valley Power Co., with a capital stock of $200,000, of which $30 has been subscribed.

Eureka Cal.—The Humboldt Gas and Electric Co. has been incorporated with a capital stock of $1,500,000, shares $3 each, $15 subscribed.

Visalia, Cal.—The Exeter City Water Co., with a capital stock of $25,000, shares $25 each, has been incorporated with $125 subscribed.

Redwood City, Cal.—The San Mateo Water Co. has been incorporated with a capital stock of $500,000. Jos. Levy, W. F. Turnbull, H. N. Royden, J. A. Foster and C. N. Kirkbride have each taken one $100 share.

Los Angeles, Cal.—At the last meeting of the City Council, held February 25th, there was a discussion of the proposed water bond issue of $23,000,000. No definite action was taken.

San Francisco, Cal.—The Green Creek Electric Power and Water Co. has been incorporated here by G. E. Weaver, J. G. Weir and E. T. Zook, with a capital stock of $5,000. Shares are $1 each.

Los Angeles, Cal.—The Lockwood Oil Co. has just been incorporated with a capital stock of $500,000, $25.00 being subscribed by T. Spellacy, P. E. Spellacy, C. S. Young, W. M. Wallace and J. D. Thompson.

Los Angeles, Cal.—The Cresceus Oil Co. has been incorporated here with $320,000 capital stock. There has been $25.00 subscribed by J. D. Lundregan, J. L. Scott, John Conley, T. and P. E. Spellacy.

Fresno, Cal.—The Elaine Oil Co. has been incorporated with a capital stock of $300,000, by Z. L. Phelps, W. C. Reilly, E. W. Robinson, John Mills, Arthur E. Webb, E. A. Webb and S. J. Riley.

Santa Barbara, Cal.—The Yucca Oil Co. has been incorporated to develop petroleum. The capital stock is $500,000 and the incorporators are J. F. Forbes, H. H. Younken, Stone Hastain and others, all of Orcutt.

Los Gatos, Cal.—With a capital stock of $200,000 the Los Gatos Ice, Gas & Electric Co. has recently been incorporated here. Shares are $16 each. Jay Deming, G. W. and C. E. Hume, J. D. and Bessie Farwell have taken one share each. Place of business, San Francisco.

Santa Maria, Cal.—The Prince Canyon Oil Co. has incorporated with Geo. Doane, Jr., T. B. Adams, L. C. Mau, and others, directors. They will get the best machinery and begin drilling on the Price Ranch, near the Tiber Company's well. The property is located a few miles from Oilport.

Fresno, Cal.—The Skookum Oil Company has been incorporated with a capital stock of $300,000, of which $100 has been subscribed by A. D. Ferguson, of Fresno, R. L. Patterson and R. W. Dallas, of Coalinga, W. E. and H. H. Dingley, of Lemoore, $20 each.

Hanford, Cal.—With a capital stock of $25,000 the Lemoore Ice and Power Co. has been incorporated here. Shares are to be $1.00 each. H. C. Watson, Gus Merz, W. E. Dingley and others have subscribed $3,625. Lemoore is to be the place of business.

Red Bluff, Cal.—There has been incorporated here the Coneland Water Co., with a capital stock of $100,000, the shares being $1.00 each. The directors in the new concern are G. G. Kenoyer, A. M. Ross, J. E. Widner, P. F. Byrne and Alvin Dunn, all of whom reside in Los Molinos.

Visalia, Cal.—An assessment has been declared by the Lindsay Heights Water Co. which was due February 1st. The sale day has been set as March 9th.
ington. Three units of 10,000 horsepower each will be added at a cost of $250,000. It will take nine months to complete the work.

Tacoma, Wash.—Announcement was made February 20th of the dissolution of the firm of Davis Bros. Electric Co., the firm being absorbed in a new corporation which has just been incorporated under the laws of the State of Washington, with a paid-up capital of $150,000. This means the establishment in Tacoma of the largest electrical fixture manufacturing plant on the Pacific Coast. Marcus C. Davies is president of the new corporation.

WATER WORKS.

Dinuba, Cal.—A special election has been called by the Town Trustees for March 16 to determine whether an indebtedness of $15,000 shall be incurred by the city for the purpose of acquiring, constructing, managing and repairing pumps and other works necessary and proper for supplying water for municipal purposes.

Phoenix, Ariz.—Phoenix now has money in the bank with which to buy the city water works just as soon as Congress gives permission. Notification has been given by the Phoenix National Bank that it stood ready to honor the check of the city treasurer for any sum not exceeding $240,000, the money being the proceeds of the sale of the city water works bonds to Todd & Co., of Cincinnati.

San Diego, Cal.—Within a few days the work of installing a pumping plant on the block on University Heights in which is located the city reservoir will be started. The work has been ordered by the Board of Public Works and this pumping plant will be used in emergencies to fill the 160,000-gallon tank on block 15, which has been constructed to supply water to residents within a district of twenty blocks.

Oakland, Cal.—The resolution of the city council requesting the People's Water Co., the Oakland Gas, Light and Heat Co. and the telephone companies to lay down conduits, pipes, etc., on East Fourteenth Street from Twenty-fourth Avenue to the eastern boundary of the city, before the beginning of paving on that street, was referred to the city electrician by the board of public works.

Oakland, Cal.—The People's Water Co. is planning an extensive system for piping water to Berkeley which will be adequate for many years to come. An immense well has been sunk in the San Pablo lowlands which will supply the town with 5,000,000 gallons a day. A large dam will be built on San Pablo Creek, which will be built of solid concrete and is to stand 150 feet high. The water from this reservoir will be carried to Berkeley through the hills below Wildcat Canyon.

Suisun, Cal.—A communication has been received by the town trustees from the Suisun Lumber Co. stating that arrangements are being made by the company to install a pumping plant for its own fire protection. It was proposed that if the town would supply about 300 feet of four-inch pipe the company would connect its plant to the town mains and in case it was ever needed could pump water from the slough and give pressure all over town for putting out fires.

Los Angeles, Cal.—Work on the Los Angeles aqueduct will commence on the open cut from the intake of the Owens River to the north end of the Alabama hills, twenty-three miles long. The canal will be dredged with a centrifugal pump and operated by electrical power. Plans for boat and machinery have been made, and bids for supplying the machinery are now being advertised for. The boat or scow upon which the centrifugal pump will be carried will be thirty feet long. It will be built of steel in sections of a size convenient for handling, the estimated cost being $1,100. The dredging machinery consists of a cutter, a centrifugal pump and three motors. Power will be developed from Division Creek for operating the dredge and lighting the works by laying 5,100 feet of twelve-inch pipe and installing a Pelton wheel and the electrical machinery required to furnish 200 horsepower. Engineer Mulholland estimates the total cost of power plant, dredger and lighting at $17,500.

ILLUMINATION.

Los Angeles, Cal.—A franchise has been granted by the Supervisors to the Pacific Light and Power Company for a pole-and-wire line to Dominguez.

Las Vegas, N. M.—The New Mexico Insane Asylum has been authorized to issue bonds for $105,000 for needed improvements. Among these will be a power house and electric light plant.

Haywards, Cal.—The privilege of laying gas pipes and supplying the streets and buildings of the town with gas for illumination has been granted to the Suburban Electric Light Company of San Leandro.

Los Angeles, Cal.—The City Gas Company is rushing preliminary work preparatory to building a large plant and laying a system of distributing mains. A. Ross, the general manager, has opened an office in the Wilcox building and has received subscriptions to the amount of $1,000,000.

Healdsburg, Cal.—No action was taken at the last meeting of the Town Trustees relative to the granting of a franchise to D. Wickersham for the maintaining of a gas plant in this city. It is expected that the matter will be taken up at a later meeting.

San Francisco, Cal.—The Board of Supervisors has passed the ordinance fixing the water, gas and electric rates for the year. The legal charges will be the same as during the last year, namely, 85 cents per 1000 for gas, 9 cents for 1000 watt-hours for current, with a minimum meter charge of $1 a month.

Campeche, Mexico.—This city, the capital of the State of Campeche, is to have a modern electric light plant. L. B. Spyer & Company, the bankers of the city, have been granted the exclusive privilege for twenty years of furnishing electric light and power for the city of Campeche. The company will soon be incorporated by Mr. Spyer and his associates with a capital stock of $300,000.

Santa Paula, Cal.—At the next meeting of the City Trustees the Ventura County Power Company will present an application for a franchise to lay gas lines through the streets. Hon. Robert M. Clarke is the attorney of the company. It is probable that a special permit will be granted, allowing the company to start work immediately before the necessary time to advertise the sale of the franchise has expired.

Greenville, Cal.—J. C. Young, a merchant and rancher of Taylorsville, is gathering statistics with a view to installing at Taylorsville an electric light plant for the purpose of supplying the entire Indian Valley, including the towns of Greenville, Crescent Mills and Prattville. Recently Mr. Young purchased the milling plant of J. W. Thompson, and with the plant a water right for power purposes. The power consists of about 10,000 inches with a fifteen-foot drop. Mr. Young proposes to organize a stock company.

Eureka, Cal.—Competition is promised for the benefit of Eureka gas consumers. For the last two years there have been two electric lighting companies supplying the town, and the same rivalry is now to be extended to all departments of the illuminating industry. Articles of incorporation have been filed by the Humboldt Gas and Electric Co., which is backed by virtually the same interests that control the North Mountain Power Co. The plant to be erected will be solely for the production of gas. F. J. Koster, one of the prime movers in the enterprise, stated that the aim of the company is to give Eurekans a thoroughly modern and reliable gas system. The gas works will probably be located on property owned by the North Mountain Power Co., adjacent to the auxiliary station in the east end. As to the cost and equipment nothing definite has been decided. The contract for the new works has not been let, but bids will soon be called for. The capital stock has been placed at $1,500,000, and has been divided into 500,000 shares at $3 each. The original subscribers to the stock are Gordon Blanding, John L. Koster, Wm. Carson, Harry P. Vance and Henry Deering, each having taken one share. They also constitute the board of directors for the first year.

FINANCIAL.

Porterville, Cal.—The Pioneer Water Co. has declared an assessment of $1 per share, delinquent April 5th; sale day, April 26th.

Tulare, Cal.—The Visalia Midway Oil Co. has declared an assessment of .006 per share, delinquent April 15th; sale day, May 15th.

San Francisco, Cal.—An assessment of ten cents per share has been declared by the New Center Oil Co. On April 1st the assessment will be delinquent; sale day, April 16th.

San Diego, Cal.—This city voted and issued $795,000 in bonds March 12th. The money is to be used for municipal improvements, chiefly extension of water and sewer systems. There were seventeen items, carrying a total of $884,000. Three of the minor ones were defeated.

San Bernardino, Cal.—A $1,000,000 bond issue for the extension of the San Bernardino Traction Co. has been arranged through the Los Angeles Trust Co., which secured the bonds. Under the trust deed the company will issue five per cent. bonds of the par value of $1,000 each, interest payable semi-annually and maturing March 1. The transaction is signed by A. C. Dennan as president and A. G. Kendall as secretary.

Round Mountain, Nev.—Probably the largest deal ever closed in this district was consummated when the Round Mountain Daisy Mining and Milling Company purchased all the water rights in the district for $185,000. The rights, include all the water in Jefferson Creek and the springs on the Shoshone and Indian ranches. The supply is sufficient to furnish all the mines in this portion of the country with water for milling purposes. The Daisy Company is now constructing a large reservoir and is preparing to furnish the miners of this part of Nye County with all the water they need for milling purposes.

San Francisco, Cal.—The United Railroads of this city have issued a statement of gross earnings for last December and the year 1906. The December gross receipts were $562,200, or $68,804 less than for the same month in 1905. According to the company's statement, gross earnings for 1906 amounted to $5,955,787, as compared with $7,059,003 for the preceding year. No mention is made of its operating expenses. Local investors have bought an additional million dollars worth of the bonds of this company. This means that $18,000,000 of these securities are now held in San Francisco. It is said that less than 200 shares of the street railway syndicate's $40,000,000 of stocks are held in this city.

Fresno, Cal.—H. E. Huntington, of Los Angeles, is the head of the Sierra Nevada Electric Co., which was incorporated in this city last week. It carries a capital stock of $1,000,000. The company purposes to supply power for lighting and irrigation for the greater portion of the San Joaquin Valley. With Huntington in the project are associated William G. Kerchoff, A. C. Balch, J. S. Eastwood and Frank H. Short. It is believed that the recent forming of the company was hastened by the recent change that was made by the United States Bureau of Reservations, whereby the Department of Forestry was accorded unlimited control of the timber and water reservations in both California and Nevada.

TRANSMISSION.

San Francisco, Cal.—A contract has just been closed with the Westinghouse Electric and Manufacturing Co. for the power house equipment for the new plant of the Battle Creek Power Co., on Battle Creek, Shasta County. Two of the generating sets are of large capacity with generators of 4,000 kilowatts each, and the third generator is of 2,000 kilowatts. They will generate three-phase, sixty-cycle current at 6,600 volts, which will be stepped up to 45,000 volts for transmission. Three Pelton impulse water wheels with an aggregate capacity of about 12,500 horsepower will be directly connected to these generators. Exciters and auxiliaries are included in the contract.

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General Electric Co.
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Hall, Leon M.
Hunt, Mirk & Co.
Jackson, D. C. & W. B.
Kilbourne & Clark Co.
Smith, Emery & Co.

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The Engineers', Architects' and Builders' News

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THE

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The Engineers' Architects' and Builders' News

VOLUME XVIII. SAN FRANCISCO, CAL., APRIL 6, 1907 No. 14

Unique New Swiss 40,000-Volt Switch and Automatic Relays.

The accompanying illustrations and drawings show the details and method of construction of a new 40,000-volt automatic switch and various types of relays which are of the greatest importance at the present time in high tension power transmission work. These switches and relays were designed and constructed at Baden, Switzerland, by Brown, Boveri & Co., Ltd., and many similar devices are now employed in important power generating stations in America.

For many years past in order to prevent any dangerous overloading of machines, apparatus and cables, easily fusible metal strips calibrated to carry the normal working current and generally fusing with double the working current strength, were inserted in the leads. Originally, when only small current

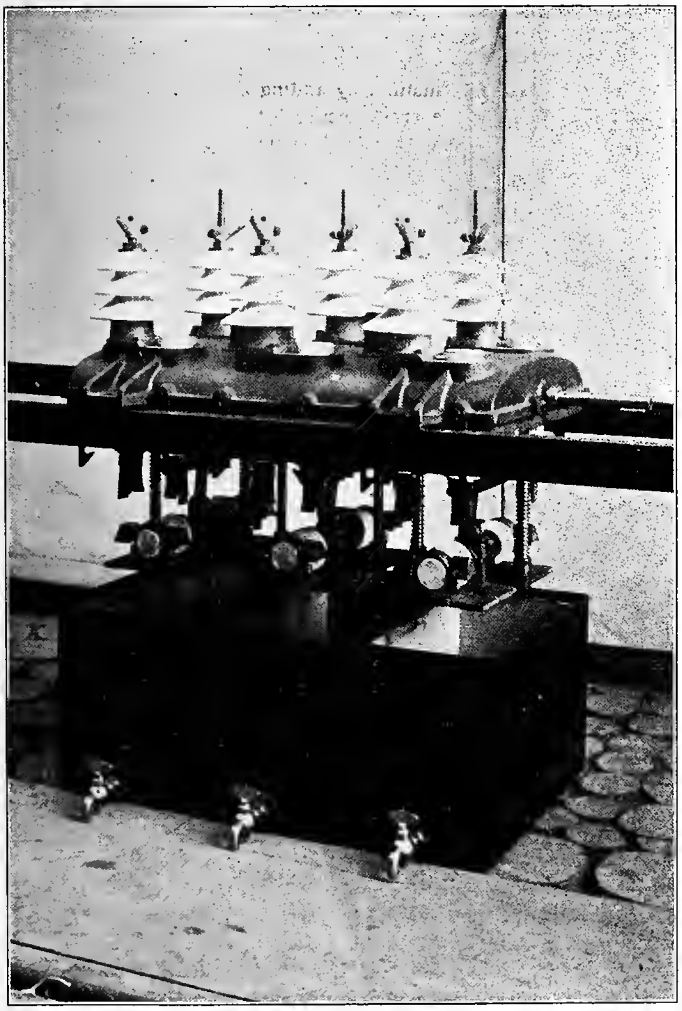

Fig 1. Swiss 40,000-Volt Automatic Oil Switch

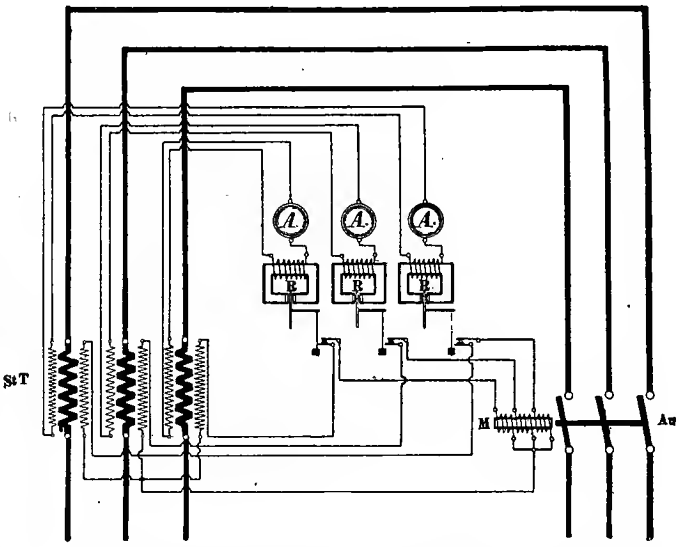

Fig 2. Connections of Swiss Automatic Switch with Three Pole Overload Relay with Alternating Current Triping Solenoid.

St. T.—Current Transformer. A.—Ammeter.
R.—Overload Relay M.—Tripping Coil.

strengths came into consideration, this arrangement sufficed, but with the growth of engineering, the output of machines increased, and at the present day when machines giving 1,000 horsepower and more are built many difficulties arise through the adoption of fuses. If dealing with heavy currents of medium voltage the dimensions of the fuse strips are considerable and the calibration is inaccurate, as the current strength required for melting the strips largely depends on the conditions of ventilation. The fuse is inaccurate also on account of the time which elapses from the beginning of the overload to the melting of the fuse simply depends on previous working conditions. When the conductor is only very slightly loaded the fuse remains cold up to a certain instant. If a large overload is now suddenly thrown on, a fuse with large dimensions requires considerable time before its temperature reaches the fusing point to make it blow.

In case the conductor is carrying the normal current when the same overload occurs, it will have a certain temperature higher than in the first case and will burn out much quicker. The fuse therefore only serves the purpose of protecting the machine against a dead short circuit and this in a rather unreliable manner since the glowing metal, caused through the fuses burning out, help to maintain the spark. This is often ruinous to the fusing apparatus when special arrangements are not made to carry away the fumes from the leads and apparatus, and render the gases harmless.

It will also be noted that considerable time is lost placing a burnt-out fuse, and last of all one must not forget the cost of

fuses for large current strengths. All these unfavorable conditions multiply in high tension plants when working at from 10,000 to 40,000 volts and more.

In many large European plants fuses are entirely done away with. In low tension installations it has, however, been possible for some time back to do away with fuses by making use of maxi-

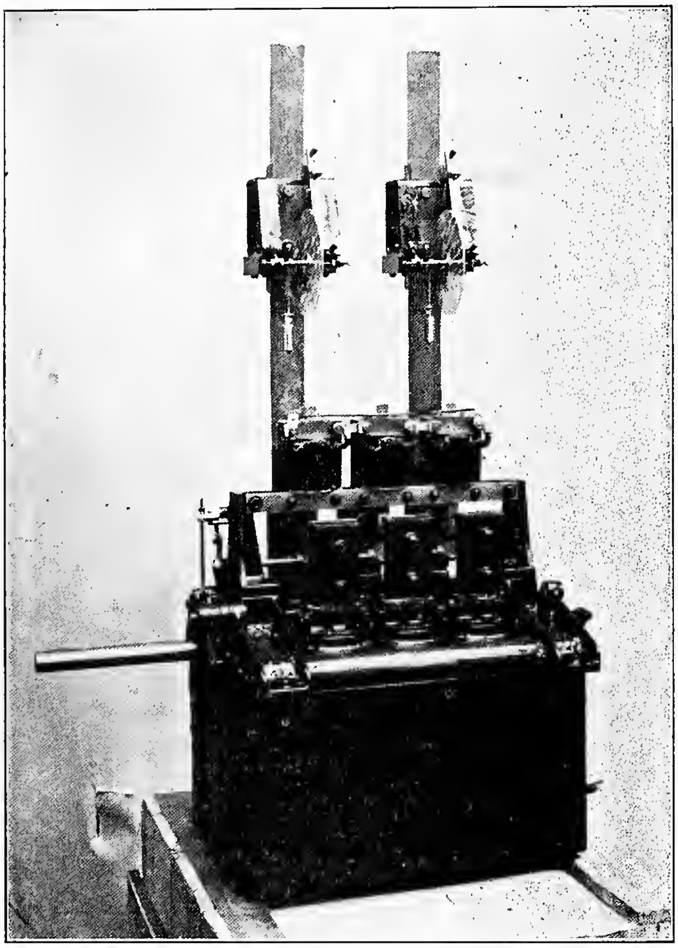

Fig. 3. Swiss Automatic Oil Switch with Overload Current Relay and No Voltage Relay.

mum current automatic cut-outs, which are operated by means of solenoids, through which the main current flows. This apparatus has its disadvantage, for it operates instantaneously with an overload of the smallest duration, a point which is, however, not desired, since it causes unnecessary interruptions in the service.

The Swiss engineers hold that when they set out to design a new automatic switch to replace the fuses, they had in view principally high tension installations. For well-known reasons, it was impossible to make use of high tension alternating currents in the solenoid portion of the switching apparatus. The choice of the type of switch was in itself not a matter of the least importance, for the same had to possess such properties as to be able to cut out the largest outputs on short circuits without difficulty and without disturbing the supply. These designers were led to make use of the oil switch, which had given entire satisfaction and which could be easily employed for automatic operation by making a few changes in its constructon.

A 40,000-volt three-pole automatic oil switch of this type of Swiss design is shown in the illustration, Fig. 1.

In designing the releasing arrangement the Swiss engineers claim to have held firmly to the point that the same should be placed where it was visible and at the same time easy to get at. On the other hand, it is the practice in high tension plants to mount the high tension switches outside of and independent from the service switchboard. These switches are operated by means of a transmission gear from the service switchboard, which only contains the measuring instruments carrying low tension current (transformer down) and the driving hand wheels. It was considered necessary, however, to separate the apparatus which was to be used to release the switch from the switch itself and to mount it on the service board. A tripping coil is mounted on the switch, which is electrically worked by the above named apparatus from an auxiliary current supply.

It must be mentioned that this relay must be operated by the supply current available. While on the one hand, however, all high tension currents were on principle kept separate from the service switchboard, and as it was also difficult to design a high tension relay, it was decided to make use of the current transformers provided for the ampere meters to supply the required low tension currents for the relays. It is well known that during actual service in an electric station small overloads sometimes occur, which, if they only last a short time, are not dangerous to the machines. In such a case an automatic switch is provided, which switches out after a certain length of time; i. e., when the overload begins to become dangerous for the machines. On the other hand, short circuits can take place which ought to be removed at once, and between these two cases every possible condition of overload exists for which a corresponding time for switching out seems necessary.

It is stated that the action of the automatic overload relay is based on Ferrari's well known principle. A light aluminum disc is arranged to revolve between the poles of a laminated electro-magnet. The electro-magnet is energized by alternating current taken from the secondary side of a transformer, the secondary current being proportional to the main current of the machine. The necessary rotary field to produce the torque on the disc is obtained in a very simple manner by adding a short circuited copper ring to cover half the cross section of the magnet. In this way one obtains two alternating fields differing in phase, these two fields giving a resultant rotating field which sets up Foucault current in and induces a torque on the aluminum disc. The spindle of the disc is horizontally pivoted and carries a small drum on which a silk cord with a weight suspended at the end is wound up.

Up to a predetermined current strength at normal load the weight prevents the disc from turning. If the working current now exceeds the prearranged figure, the torque on the disc increases and the cord with the weight suspended at its end is wound up on the drum.

As soon as the weight rises a certain height, it closes a circuit by bringing together two very light contact springs arranged in a horizontal position. A strong permanent magnet, between whose

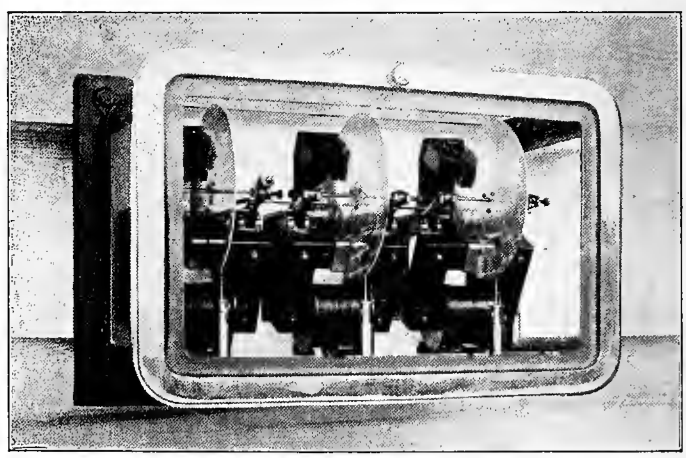

Fig. 4. Swiss Three Pole Reverse Current Relay.

poles the aluminum disc rotates, serves to damp the action of the disc and prolongs the time taken in lifting the weight. The contact springs are connected to the circuit of the tripping solenoid arranged on the switch. When the contacts are brought together the solenoid attracts its armature and the main switch, due to its own weight and to the action of the springs, operates.

About two amperes is the tripping current, and this is taken from the exciters, or from a small accumulator battery.

It will be noted that the length of the cord on which the weight is suspended the time limit may be varied, and by adjusting the weight itself the current at which the time limit device should commence to operate can be varied. The time which elapses from the moment the disc commences to rotate until the circuit for the solenoid is made depends also on the extent of the overload, so that the time is long when the overload is small and short when the overload is large.

It is stated that the time required in switching out is a function of the overload current strength. The times plotted down are not fixed quantities, as they can be adjusted in each relay as desired, even when the relay is in circuit, by increasing or decreasing the length of the silk cord to which the weight is attached. The apparatus is calibrated for an overload current of 1.4 times that of the normal working current. This adjustment of the overload can be carried out on any relay and at any time. The counter weight consists of eight brass discs or washers and a brass nut, and by removing the single discs the tripping current, i. e., the current to operate the relay, can be reduced to under one-half of its original value.

It is maintained that for various normal working currents the ratio of transformation of the current transformer is altered so that the secondary current is always 1 ampere when the pointer of the ampere-meter gives its maximum deflection, this latter

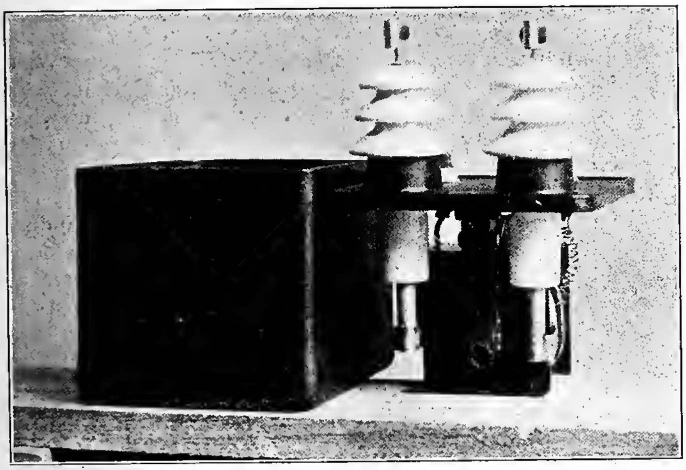

Fig. 5. Current Transformer for Feeding Relays.

being usually selected so that it is about 30 per cent above the normal working current. Every relay has this current strength, i. e., one ampere, and the same relay can be employed for any circuit, providing that the corresponding current transformers are made use of, no matter what the current strength in the circuit may be.

The usual relay employed is single pole, but same can be connected up to form two or three pole relays, if required. In single phase installations a two-pole relay is generally employed; a single-pole relay is, however, sufficient. In two-phase installations two-pole, and in three-phase installations two or three-pole relays are used. In three-phase plants with a neutral, a three-pole relay must be adopted. The tripping contacts in the multi-pole arrangements are connected up in parallel.

Of course, with the apparatus described above it is necessary to have continuous current for the tripping coil of the switch. Continuous current is always available in a central station, but on the other hand, it can happen that this current is not at one's disposal, as, for instance, in a transformer substation, and to obtain which one prefers not to employ an accumulator battery. For such cases these Swiss engineers have designed a tripping device to be operated with alternating current.

As is well known, it is not possible to actuate the tripping coil by employing a tension transformer only fed from the network, for at the very instant that the relay should operate, for instance, on a dead short circuit, the drop in the voltage is very great or the tension disappears altogether. The tripping device must, therefore, on this account be actuated by a current transformer.

On a three-phase system it might occur that the overload or short circuit occurs on one phase only, and it is for this reason necessary to feed the tripping device from at least two phases of the system. As current transformers are always available for the standard type of overload time limit relays, the former can at the same time be employed for the tripping device by winding a second coil on the core of the current transformer. This winding generally remains open, but is switched onto the tripping coil mounted on the main switch by means of the time relay as soon as the latter starts to operate, so that the mechanism of the tripping device opens the switch.

It is maintained that in order to keep the phases separate from one another, two or three seperate tripping coils mounted on the core of the tripping device are employed in connection with a two or three-pole relay respectively. As it is neccessary to only know the current flowing in one phase of the system, this can be done by observing the ammeter in that phase, a two-pole relay in conjunction with only two current transformers is sufficient for a three-phase system, provided, of course, that the neutral point is not earthed. In this latter case, however, a three-pole relay must always be employed.

A relay for direct mechanical tripping has been constructed at Baden, Switzerland, by Brown, Boveri & Co., for certain cases when the relay is not required to operate with great accuracy and when a very simple arrangement is required for tripping the switch without having to employ a separate tripping circuit. This mechanical relay, which is based on the same principle as the one just described, is so constructed that it trips the switch directly. It also consists of an aluminum disc which rotates between the poles of a laminated iron core carrying a current coil and is also with a short circuited ring. A weight attached to the end of a lever which can be rotated is employed instead of the cord with the weight suspended at the end, and this weight is raised by the spindle of the aluminum disc operating through mechanical reduction gearing. On the weight being lifted a certain height it is released and falls back to its original position, striking the pawl arranged on the tripping mechanism of the switch and enabling the switch to open.

It will be noted that this relay is also a time relay, but the time element cannot be varied as in the case of the one described above, in which the time element is varied by adjusting the length of the cord carrying the weight. This relay is further not so sensitive, as this depends on the condition of the reduction gearing, which consists of two small spur wheels having a certain amount of friction.

A Swiss relay of this form has been mounted direct on a two-pole 8,000-volt switch. The current coil is fed with low tension current from a current transformer, which also at the same time serves for the necessary ampere-meter on the respective switchboard. This arrangement is employed in carbide works when the transformers are subject to very heavy overloads. This relay switches out in 30 seconds with an overload of 50 per cent, or in five seconds when the overload is two and one-half times that of the normal load.

The Brown-Boveri no-voltage and overload relays are used advantageously in connection with large alternate current motors. Owing to a very ingenious combination, the employment of a special tripping circuit has been avoided. A description of same is given below. On the switch there are arranged, as the case may be, viz: single, two or three-phase motors, one, two or three magnet cores respectively, which are held up by means of tension coils, these latter being energized directly from the leads to the motors. As soon as the tension on these leads, owing to some reason or other, disappears, the magnet cores fall and in dropping release a pawl and trip the switch.

It may be stated that in order to also make use of this "No-Voltage" switch as an overload switch, one, two or three-pole overload time limit relays are connected up in the motor circuit, and these relays are so arranged that on the relay operating a circuit is opened and not closed, as in the case of the standard apparatus; that is to say, the circuit of the "No-Voltage"

coil is opened so that this latter again releases the pawl of the tripping mechanism on its particular switch. If the corresponding driving gear of the switch is now combined with that of the starter of its corresponding motors so that the switch after it has switched out can no longer be switched in till the lever of the starter has been brought back to its original position, one obtains a switching arrangement such that the motor is fully protected against an overload which would be too large, or against a wrong manipulation, or also to allow it to remain switched in when the tension disappears.

The reversible current relay is another important device now largely utilized in electric power plants to advantage. The apparatus above described deals with the overload relay which does the work of preventing the machines from giving out or receiving too large a current. This relay ought consequently to be capable of tripping the switch as soon as the current reaches a certain value, no matter whether the direction of the current vector is normal or reversed. One can see from the principles upon which the relay works that it fulfills these conditions. The resulting torque depends solely on the strength of the current and is not affected by the power factor of the circuit. As long as the current keeps within its predetermined limits the particular electric machine which it protects can receive or give out energy without the relay being affected by the direction changed of the flow of energy.

Under certain conditions, however, a reverse current relay may be necessary, as when in an electric generating station in which a number of generators are working in parallel, it might happen that the mechanical regulator of one of the generating sets gets out of order and when the load of the station increases this set may cease to do its share of the work and may entirely fail to supply any energy whatever. The generator may even be driven as a motor receiving current from the other machines. The current as shown by the ampere-meter may under circumstances remain within its normal limits so that no change is observed in the working conditions of the set, although a considerable waste of energy takes place.

Another like condition occurs when two central stations working in parallel the mechanical speed regulators, in the distribution of the load, are not adjusted to work exactly alike so that under conditions of small load it can happen that one plant is driven by the other.

A very common case worth noting is when a synchronous motor which is connected to a long-distance transmission line works in conjunction with mechanical prime movers or with electric motors driven from an independent source. Should a fault now occur in the central station or an earth on some portion of the transmission line, so that the supply of energy is cut off from the sychronous motor, the motor would now be driven as a generator and would supply electric energy back to the line.

It is therefore held with truth that the overload relay, as well as fuses, under certain circumstances do not meet with all the requirements of the service and the new reverse current relay becomes of great value.

It will be noted that the reverse current relay operates when the flow of energy is reversed, that is to say, the current and tension influence the apparatus. The general arrangement of the reverse current relay is very similar to that of the overload relay, except that the former is provided with two electro-magnets; one tension and one current coil per pole. Short-circuiting rings are no longer necessary, as the two magnets help to form the rotating field. The field produced by the current coil is approximately in phase with the working current of the line, that produced by the tension coil lagging approximately 90 deg. behind the tension. A time limit tripping device is not necessary in a reverse current relay. The aluminum disc is held in check by means of a weight attached to the end of a silk cord, which latter passes over a small drum.

As long as the flow of energy is in the right direction the aluminum disc is prevented from closing the tripping solenoid circuit by means of a catch, but on the direction of the flow of energy being reversed and on the energy rising above a certain figure, the disc makes a complete revolution and closes the circuit of the continuous current tripping solenoid on the switch.

In monophase and diphase plants single and two-pole reverse current relays are utilized and in polyphase installations a two-pole relay with two single-phase tension transformers is made use of, if the two-wattmeter method of connecting up is employed in connection with reverse current relays.

It is claimed that the reverse current relay can also be used in conjunction with an overload relay by making use of the same current transformers. In this case the current coils of the overload and reverse current relays are connected in series with the secondary side of the current transformer.

It is stated that in many instances these relays are mounted on existing switchboards, as in nearly all large plants in England, although the switches, of course, have to be provided with tripping coils for the automatic releasing.

COPPER MARKET SITUATION.

The trade has again witnessed a farther advance in market prices for copper during the past thirty days, and consumers are now confronted with conditions that seem to indicate a continuance of the same undertone of strength which has been the recent feature for all kinds of copper. Important new engagements have been entered into by consumers for shipments in April, May and June, and purchases for those months have consequently relieved sellers of a good share of the output between now and next July. Quotations are now on the basis of 26@26½ for Electrolytic Wire Bars for late future deliveries, and 26@26½ for prime Lake brands. Prices on recent contracts have been somewhat diversified, and buyers have been forced to pay premiums for prompt deliveries, while the distant futures are procurable for a little less than spot copper.

Conditions in the copper and brass manufacturing industries are good, but the operations of these interests could be carried on in a more satisfactory manner, in some cases at least, if it were always possible to obtain plenty of raw material for the three months immediately ahead. Consumers are not particularly concerned about the price of copper, but that which chiefly interferes with the conduct of their business along normal lines is the inability to get copper in sufficient quantity for delivery within 60 to 90 days, so that the entire machinery of their establishments may be kept continuously going at full capacity.

To secure full supplies it is necessary to contract for them four or five months in advance, and in our judgment this course becomes too great a speculative proposition, with values at the present level, to harmonize with the principles of a sound, conservative business policy. Whether copper costs the manufacturer 25 or 30 cents a pound is a question of secondary consideration. The essential thing for the consumer is the ability to secure metal in the quantities wanted and at the time wanted. There exists a good demand for copper at present, and when this is the case it can be turned into a manufactured state, delivered and paid for in a reasonable time. But to assume obligations and enter orders of an enormous aggregate, and then have to wait from four to six months before a fulfillment of these can be accomplished, this is an ordeal of too exacting a nature for legitimate manufacturers to assume without placing a heavy premium upon their capacity for business acumen. The strain upon credit inseparately connected with the process is in danger of becoming too intense for the preservation of a healthy tone in the situation. When credits and purchases are kept within reasonable periods the risks of business are thereby maintained at a limited scale, but when obligations and contracts are allowed to become unduly extended there is the liability to overstep the safety line. Our plea is for those principles and methods that will best conserve the interests of all concerned, and which will tend to promote progress and develop the expansion, on thoroughly safe lines, of the varied interests identified with copper.—*From Copper Gossip.*

WHAT KIND OF TECHNICAL TRAINING IS BEST FITTED TO ATTAIN THE SERVICE IDEAL?*

We will assume the service before our minds is that which is needed in an industrial community engaged in production. This latter I will define as the process of increasing wealth resulting from spending labor upon a raw material or a product of the soil. I think an older ideal that education should be so directed as to fit every boy to rise to be President of the United States in one which has worked harm upon our practical thinking. It is manifestly impossible within seventy years of a man's natural life that more than a very small number of the many millions of our population should ever reach this eminence. What of the many debarred from this possibility, but who must yet be wage earners?

In the forwarding of modern economic production it seems to me there is a demand for three kinds of ability. The education in the community should be directed to discipline and knowledge in each field of service. This recognizes the generally received analysis that under the board of directors of a manufacturing corporation will be the three departments, which may be designated as the works or productive department, the office or accounting department, and the sales department. In developing this analysis, it will be plain that the largest group numerically will always be the artisan or craftsman class, who work with their hands upon the raw material, either directly or through the media of tools. These tools they do not or have not designed, but they operate them and make them go. These are the workers at their respective trades; they enter them as bread-winners or producers after their childhood's contact with the public school, and either after their contact with such schools has become completed, or before. For this great group it seems to me that the call is the loudest that proper provision be made that they should be specifically fitted for usefulness by the education which they receive before going to work, or which they may receive during its continuance. Their numerical importance makes industrial education for such persons a splendid opportunity for those who are gifted with vision and with wealth to render their service in this form. This education need not be deep nor decorative, but it should be broad and practical. It should be so directed that it may be an inspiration for the daily toil required of those who must be wage-earners as a means of personal or family support, and who must be economically productive from boyhood. It should cover the scientific and natural laws behind the material things which they handle or control. It should reveal the intellectual and philosophic basis of their life, making it not unworthy of the divine element in man. It must make him more than a mere high-class automatic machine. It must show the man that he is greater than his work and that this latter is a means and not an end. It must show him that possibilities of growth and achievement are his personal right, even while he appears to be contributing only as a unit in the productive process. All honor to wealth and to achievement, which have seen and shall see this opportunity of service to the craftsman and shall move forward to meet the demands for industrial education among the wage earners.

A second class will be the organizers and directors of the craftsman, who, together with their machinery and plant, form the producing apparatus which we call a factory or mill or works. In this group will be the general managers, the draftsmen, the engineers, the superintendents and the industrial organizers. To this class belong the product turned out by the engineering schools. The young engineer in either the mechanical or electrical specialization of the day is likely to be a manufacturing engineer. They must necessarily constitute a smaller class than the preceding, but from their duties and function they will be the best paid. They are the most vitally essential under modern competitive conditions, where conformity to physical law is imperatively demanded if success is to be won without its costing too much. For these men knowledge of the crafts which they are to control is essential, but even more so a knowledge of science and its laws, covering familiarity with accepted solutions for old problems and the trend of research into new ones. For such men beside the class-room, the laboratory, the drawing-room and the school-shop, will form the desired equipment. All honor to Clarkson and to other institutions of like grade and character who are seeking to satisfy this call. The usefulness of such institutions is deep and is far reaching because profound. It is not so broad nor so far reaching in the other sense because the numbers affected are less.

The third type of service is rendered in the office and in the commercial functions of the producing process. Such service is rather what is technically designed as "personal" service rendered to the producer class rather than a direct contribution to community wealth. The compensation of such persons is a draft upon the producing cost, and hence they ought not to be too numerous. They help the easy conduct of the production process and will be fitted for their work, both by special commercial training such as is offered in business colleges and correspondence schools, and by such general education as shall give them broad views, a wide range of adaptability and a capacity for suggestive recommendation in their appropriate field. The tendency, however, of modern intensive production is to reduce this class to its lowest terms.

I put, therefore, the education of the craftsman group as the first or prime need of a service education because affecting the greatest number of the producing class. I put the education of the selected group of designers, works managers and directors of production as second only to this opportunity by reason of the less numbers affected, and not by reason of any misapprehension of the importance of having the duty of these men well done.

How May You Personally Attain this Ideal of Service?

The final stage of my argument must seek to make the theory of the foregoing apply as a personal matter to each one of us in his practical affairs if it is sound. For there is no such thing as rendering a real service if it is of no use to any one. How can we be made useful by reason of our training; or how can technical education make us useful?

I shall be satisfied if I can fasten two practical answers. We will, of course, be made useful and render service almost in our own despite, if we engage in economic production and apply our talents and knowledge and skill to this end. But higher than this and as a means of making the best of ourselves, I would specially urge that each should so labor that every study and every problem and every law is made a compulsion that we should think.

I have condemned already the mechanical-recipe system of working out solutions by rule, and without much thought. This may be used to make a well-informed man, but it will not make an educated one. The two terms, "educated" and "well informed," are not synonymous. I demand that the process of education should be so directed and planned the powers of the student's own mind shall be awakened, stimulated and compelled to exert themselves. The mechanical laboratory is particularly well adapted to secure this result, because, from the practical and material apparatus before the student's eye and under his hand, he can be forced to consider the connection between his mental concepts and the actual occurrence before his senses. He should be compelled, first, to think clearly and definitely and to enunciate what the experiment is aimed to show. He should then create or assemble apparatus suitable and necessary to answer his inquiry or to prove his assertion. He should then so arrange the apparatus as to make it truthful and accurate in its reports, and give his reasons why or to what extent it is thus reliable. He should then record and finally discuss his observations upon the forces and laws at work before him.

*An abstract of an address by Frederick Remsen Hutton, E.M., Ph.D., at the Charter Day address at the Thomas S. Clarkson Memorial School of Technology.

While it is a manifest labor-saving process to furnish the laboratory student with printed log blanks, having headings previously worked out over the columns which are to be filled with his observations, I consider that such labor is saved at an educational expense of a greater equivalent. The man may complete more experiments by the log-blank method; ;but by the other system the experiments, which he had made under it, are parts of his mental, as well as his bodily experience. They have, furthermore, compelled a mental activity which is a calisthenic exercise in itself, and which leaves him a different man and a better one than he was before. I have condemned already the danger of smooth and facile lectures taken by a free election and without reference to the student's own needs. Education should teach a man the meaning of a task as a thing to be done, whether he likes it or not, and should also teach him to use his mind upon his task.

The other thing which I would urge is that the subject-matter or content of the experimental study to be used as discipline, be chosen from among the play of laws and forces, which concern the common and usual experiences of an industrial life. The purpose of this recommendation is to minimize the difference in atmosphere and condition at the educational center from that which is sure to prevail in actual life. There must be a difference, since the unit or standard of measurement in real life is the dollar, while that most suitable for the educational institution should be one which is not a variable with expediency as its exponent. In working under Nature's laws in practical affairs it is as true for us as for the old writer that all things in accordance with such laws are lawful for us, but all things are not expedient. At the school the learner must have it brought home to him, and clinched, that Nature cannot be lied to nor deceived. She insists upon truth in the inward parts, and must be obeyed, no matter what it costs. The training in what is practically economically possible under Nature's laws and what is, therefore, expedient, must be the function of life itself after leaving the school, and the best of us can only hint at such matters in the educational process. Within the limitations, however, which are set by the conditions, let the learner get in as close touch as possible with the facts and phenomena of the world of practical affairs. The technically-educated man has this great advantage over his academically-trained associate—that for the latter the classic languages, the civilization of dead nations and their history, refinements of pyschology and even some forms of literature and antiquarian research are without immediate relation to the functions which the man is to discharge when he becomes a worker. Never have I seen this more tersely put than in the epigram of Prof. John E. Sweet, of Syracuse, when he compared the usefulness of him who knew "what to do and how to do it," with that of another "who only knew what had been done and who did it."

THE DEADLY ELECTRIC WIRE AND THE CONDITIONS UNDER WHICH IT IS MORE OR LESS DANGEROUS.

The danger incurred in touching an electric circuit does not depend wholly on the voltage or electric tension. Two-thousand-volt circuits have been touched with impunity, and contact with incandescent-light circuits of only one hundred and twenty volts has caused instant death.

The physiological effects of electricity are due partly to electrolysis or decomposition of the blood and other fluids and partly to paralysis of vital organs. Both actions are proportional to the strength of the current that actually passes through the body, and this current strength is equal to the voltage of the circuit touched divided by the electric resistance of the body. The average resistance measured between a hand and the feet, when the hand is moist and the shoes are soaked with water, is about 5,000 ohms. A current of one-twentieth of an ampere—one-tenth of the current used in an incandescent lamp—may cause death. Hence, the question is, Under what conditions will contact with an electric wire send such a current through the body?

If the right hand touches one wire and the left hand simultaneously touches the other wire of a 110-volt incandescent lighting circuit, the body, assuming its resistance to be 5,000 ohms, will be traversed by a current of 110-5,000 ampere, or little more than one-fiftieth of an ampere, which is within the limit of safety. But if the hands are dry the resistance measured from hand to hand is fully 10,000 ohms, so that both wires of even a 220-volt circuit, such as is used in some incandescent lighting systems, can be touched without danger of serious injury. In certain factories, however, where the air is damp, warm and laden with acid vapors, the skin becomes softened and the resistance so greatly diminished that it is not safe to touch both wires of even a 100-volt circuit.

The writer's left hand once came so near the terminals of a 1,000-volt transformer that it drew luminous electric arcs from them. The current, having so small a resistance—less than two inches of the hand—to overcome, was very strong, but it caused no injury except local burns, because it did not traverse a vital part. In instructive contrast to this case is the experience of the inventor of an electric bath tub containing metal plates that could be connected with a 220-volt lighting circuit. The inventor tested the device on himself and was instantly killed because soaking in water had so reduced the resistance of his body that even this low voltage produced a deadly current.

If a man, standing on a trolley rail or even on the ground, touches a broken trolley wire carrying the usual pressure of about 500 volts, a current of one-tenth of an ampere will pass through his body, if its resistance is 5,000 ohms, and will probably cause death. In this case the ground or the rail represents the second or return wire. It is much less dangerous to touch a single wire of a double-wire circuit, well insulated from the ground, for in order to reach the other wire the current that traverses the body must flow through or over some of the insulators, that is to say, through a very great resistance, so that the current is very weak. But in a very long line the sum of these little leakage currents through many insulators may be too great for a human body to carry with safety. Hence, the danger is proportional to the length of the line. Simultaneous contact with both wires of a high-voltage circuit is, of course, fatal.

The static electric charge of the wire, as distinguished from the flowing current, is another source of danger, at least in alternating circuits. In continuous-current circuits this charge acts only once, at the first instance of contact, but in alternating-current circuits the charge is changed from positive to negative and back to positive usually about one hundred times a second, and when a man touches the wire the electricity which forms these charges surges back and forth through his body. Most of the casualties produced by touching alternating circuits are due to this cause. The danger is proportional to the electric "capacity," and therefore to the length of the wire. Burying the wires increases their capacity and makes them still more dangerous to handle, but it effectually keeps the average citizen away from them.

The danger is proportional to the frequency of alternation, if the frequency is not very great, but currents of several hundred thousand alternations per second, such as Tesla employed in his amazing experiments, do not penetrate deeply, so that when they traverse the human body their effects are confined to the skin and are not serious. The facts that high voltages and high frequencies have been commonly associated in experiments and that extremely high frequencies have been shown to be harmless, have led to the wide-spread belief that exceedingly high voltages are quite free from danger. This is entirely erroneous, as the curious reader may easily prove to his own satisfaction—or, at least, that of his heirs.—Condensed from Herman Zipp, in "Die Umbschau," and reprinted from the "Scientific American."

PILE PROTECTION.

By Coleman Meriwether, M. Am. Soc. C. E.*

The protection of wooden piles in salt water against the attack of the teredo, limoria and other marine wood borers, is a question to which engineers throughout the world have given a great deal of thought and study.

The teredo is found on the entire coasts of the United States, Mexico, South America, Africa, Australia and portions of Europe and Asia, and is most active in the United States, along the Mexican Gulf and the Pacific Coast.

The writer has made a careful study of the ravages of this mollusk, and finds that it works differently and with a different degree of rapidity in almost every locality.

The teredo only attacks a pile for the entire distance between the mudline or bottom and mean high water, but in fresh water flowing into salt water bays, the teredo almost invariably confines its attack to the bottom of the pile entirely. This is a most dangerous condition, as a pile inspected at the surface of the water may appear perfectly sound when it is eaten away at the bottom. This condition is easily explained by the fact that the rivers referred to contain both fresh and salt water. The fresh water being lighter comes to the top; the salt water being heavier goes to the bottom, and as the teredo only works in salt water, it confines its operation to the bottom portion of the pile entirely; the conditions referred to above.

Numerous modes of protection have been used, and the one which is most generally used is probably creosote. Creosoted piles withstand the attack of the teredo in some localities almost indefinitely; in other localities its succumbs to the attack in a very short time.

Mr. Alex. Stewart, assistant chief engineer of the Great Northern Railway, told the writer that he has known of cases where creosoted piles in the Puget Sound have been rendered useless in eighteen months.

Mr. D. Lombilo Clark, director general, public works of the Republic of Cuba, informed the writer that the average life of a creosoted pile in Cuban waters is from three to four years. He stated that the large government wharf at Matanzas, which was completed about four years ago, and built on creosoted piles, is badly eaten.

The writer is at present engaged in protecting piles at Pensacola, Florida, which were treated with twenty pounds of creosote per cubic foot, and have been in the water eight years. These piles are now being covered with a concrete pipe.

Sheathing the piles with copper is a common mode of protection in Central and South American countries and on the Pacific Coast. The present price of copper makes this method of protection almost prohibitive. Piles sheathed with copper withstand the attack of the teredo to a great extent.

Mr. Percy Evans, of Evans, Coleman & Evans, Vancouver, B. C., stated to the writer that they have a large wharf built on piles which are covered with copper. For some reason, which he is unable to explain, the copper sheathing deteriorates and comes off for a few inches above the mudline and renders it necessary to repair piles in this wharf with the aid of a diver, who replaces the old copper sheets with new ones.

The Louisville & Nashville Railroad Company have gone very deeply into the matter of pile protection, and Mr. R. Montfort, consulting engineer of that company, who was previously chief engineer, read a paper before the American Society of Civil Engineers some time ago, describing various modes of protection in use on their lines, stating that he thought the best mode of protection that they had used was vitrified clay sewer pipe strung over the tops of the piles. The bell and spigot ends were sealed with melted pitch, and the annular space between the pipe and the pile was filled with sand after the pipe had been placed on the pile. This method of protection has proven very effective, and has been in use on the Louisville & Nashville Railroad Company for fourteen or fifteen years; the only objection to this form of protection being that it had to be placed on new structures before the piles were capped, which delayed the carpenter forces, and if it were desired to protect an old structure, the caps had to be removed in order to place the pipe, which made the operation very expensive.

The Florida East Coast Railway used, in the past, almost exclusively, for pile protection, vitrified clay pipe, which was made in halves, having an ordinary butt joint, which were placed around the pile and wired together. The space between the pipe and the pile, in this instance, was then filled with concrete, as it was impossible to fill it with sand, owing to the fact that the butt joint could not be made tight enough to hold sand.

Mr. E. Ben Carter, engineer and general roadmaster of the Florida East Coast Railway, has stated to the writer that they have abandoned this mode of protection for three reasons; one being that the concrete caused the pipe to adhere to the pile and would not allow the pipe to settle with any scour which might occur at the mudline or bottom, and, therefore, if the scour did occur, the pile would be left unprotected at the bottom; another objection being that in placing the concrete in the pipe in deep water the ingredients of the concrete became separated in passing through the water, and that the lower pipe or two would become filled with sand instead of concrete, as the sand being heavier than the cement, would reach the bottom first. Then the sand would be washed out through the butt joint and leave two or three feet of the pile unprotected at the bottom. The writer has seen piles protected in this manner which have been entirely eaten away at the mudline. Another serious objection to this form of protection is the difficulty of inspecting it.

After carefully considering all the difficulties encountered by various modes of protection, the writer believing that pipe filled with sand affords the best protection, organized a company to manufacture a concrete pipe divided into halves, which could be placed around the piling, then filled with sand, using for this purpose a scarf lock joint, which could be sealed absolutely tight, and a joint which would hold the finest sand.

The pile trestle of the Seaboard Air Line Railway across the Manatee River Bridge at Manatee, Florida, was protected by this method about a year ago, and an inspection made in January of this year showed that on the entire structure the pipe was intact and filled with sand from top to bottom, only one section of pipe being broken; this having a round hole in it caused by a blow just above low-water line.

The method of protecting piles by the concrete pipe referred to is easily placed on structures which are in use without interfering in any way with the use of the structure or traffic over it, and can likewise be easily repaired in the same manner, by removing the broken section of the pipe and allowing all pipe above that to slip down to take the place of the broken section, and place a new section at the top.

From best information which could be gathered by the writer, the costs of various protections are as follows:

Creosote, 35 to 50 cents per lineal foot for the entire length of the pile.

Ordinary sewer pipe filled with sand, placed over the tops of piles, $1.25 to $1.35 per lineal foot for that portion of the pile which is in the water.

Sewer pipe and concrete, $1.35 per lineal foot for that portion of the pile which is in the water.

Concrete casings placed in forms, $1.15 to $1.50 per lineal foot for that portion of the pile which is in the water, according to the depth of the water.

Lock-joint cement pipe, $1.00 to $1.15 per lineal foot, placed around the pile and filled with sand, for that portion of the pile which is in the water.

*President of the Lock Joint Pipe Co., 346 Broadway, New York City.

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EASTERN AGENCIES

NEW YORK ....

CHICAGO ....

ST. LOUIS ....

WESTERN AGENCIES

LOS ANGELES ....

PORTLAND ....

SEATTLE ....

Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," with which is incorporated "The Engineers', Architects' and Builders' News."
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VOL. XVIII APRIL 6, 1907 No. 14

EDITORIAL.

Liquid and Gas Fuel Prime Movers

The invention and perfection of the steam engine was probably the most important advance in engineering resulting from the design and construction of a single piece of machinery. As a means of converting heat energy into mechanical energy the steam engine has up to the present time been more extensively used than all other heat motors taken together. Within recent years, however, the advances made in the introduction of the explosive mixture motor have been of great importance and particularly in small units for automobiles, launches, and even in comparatively large sizes for individual motor cars on either branch or main lines of existing steam railway systems. For stationary service, gas engines of very large size have been built and have in general given very satisfactory service in every case when the gas used has been made with especial reference to its consumption for the generation of power.

Commander A. B. Willits of the U. S. Navy has recently contributed an article to the Journal of the American Society of Naval Engineers, in which the probable future of the internal combustion motor as a substitute for the steam engine on shipboard is carefully considered, and his conclusions are worthy of the attention of engineers in general.

With liquid fuel he states that the following objectionable features, necessarily present with steam installations on board ship, are eliminated, namely:

No boilers,
No pipe lines under pressure,
No smoke,
No ashes,
No coaling-ship distresses,
No stoking furnaces,
No condensers to keep tight,
No forced-draft blowers,
No fuel cost or delay in getting up steam,
No fuel cost by keeping fires for "standing by."

Two other advantages given are that all mechanical operations in different parts of the ship will probably be accomplished by electrical apparatus worked by a supply current from a central plant operated by independent "gas" engines, and that the weight of the machinery for propelling the ship will be enormously reduced.

Considering the construction and operation of the motor itself, it is said there are no real difficulties at present unconquered, and therefore the ultimate extensive use of this type of prime mover as a source of power for sea-going craft depends merely upon the question of securing an economical fuel, readily obtainable at the principal ports of the world. Gasoline is an ideal fuel for the practical operation and retention of light construction in this class of machinery, while an alcohol-gasoline mixture and kerosene closely follow. It is possible to safely carry gasoline on shipboard, providing the construction of all tanks and fittings is such as to prevent accidents which can only occur from what are now well known danger conditions.

The cost of the liquid fuel, however, is a serious disadvantage. Comparing the cost of an indicated horsepower using coal at $3.00 per ton and gasoline at 15½ cents per gallon, we find that the cost per individual horsepower using coal will be less than ½ cent, while with gasoline the cost is slightly less than 2 cents, the above figures being determined under average and usual conditions. While the fuel for the internal combustion engines will probably cost nearly four times as much per unit of power as when steam engines and boilers with coal as fuel are used, nevertheless the savings due to a decreased engineer's force, decrease of fuel, expenditure for "stand-by" purposes, decrease in cost of repair and up-keep (in which retubing of boilers about every three years is a tremendously large item), and decrease in interest on cost of plant are, taken together, of such importance that the annual cost for a gasoline-motor torpedo boat will not exceed that of the steam driven vessel of the same type and power.

While for stationary use the conditions are vastly different than on vessels of the torpedo boat class, yet if the engineers of the navy are giving the liquid fuel internal combustion engine such careful consideration and believe in its availability and reliability under such

exacting conditions as always exist on naval vessels, it is certainly time for this type of prime mover to be fully tried as a source of power in stationary plants, especially since with the prospective decrease in the cost of alcohol, it may be possible to reduce the fuel cost by using a most efficient mixture of alcohol and gasoline, although it may be several years before denatured alcohol can be secured as low as 10 cents a gallon.

BOOK REVIEW.

The United States Geological Survey has issued its Report on the Mineral Resources of the United States for the calendar year 1905. An exhaustive report on the "Black Sands of the Pacific Coast" is included.

TRADE CATALOGUE.

The Holtzer-Cabot Electric Co.: This Company has just sent out to the trade several little leaflets descriptive of the following specialties:

The "H-C." Indicator or two-spot annunciator.

The "H.-C." combination return call bell and button.

Type "A" flush telephone.

A new water tight bell.

Allis-Chalmers Company: Allis-Chalmers steel ventilating fans is the subject of Bulletin No. 1418. Although dated September, 1906, this has never been distributed. It is filled with valuable information on the subject of ventilating mines, foundries, rolling mills, etc.

The Automatic Refrigerating Co. of Hartford, Conn., have issued a little catalogue regarding complete refrigerating installations of capacity suitable for small plants. The system shown is automatic throughout, doing away entirely with any attendance, and the matter of economy of operation is well shown.

ANNOUNCEMENT.

Allis-Chalmers Co. announce the establishment of a new branch office in New Orleans, located at 316 Godchaux Building, where their representatives will welcome all who are interested in any of the machinery which they manufacture.

SEATTLE MEETING OF THE AMERICAN SOCIETY OF ELECTRICAL ENGINEERS.

At a recent meeting of the Seattle Branch of the American Institute of Electrical Engineers, a letter from Secretary Pope, of the National Organization, in reply to the question of holding the National Annual Convention in Seattle during the A. Y. P. Exposition, was discussed.

Secretary Pope thought it unwise to do so as the experience in the past has shown that the sessions, when held at expositions, were not well attended, nor were as profitable as when held in a more central location, and at a time when no other attraction was going on.

His suggestion, however, that the Seattle Branch invite all engineers west of the Rocky Mountains to attend a convention, will be acted upon by the members.

For the April meeting the "Telegraphones" will be explained and exhibited by Mr. O'Reilly, and W. S. Hoskins will speak of "Electrolytic Corrosion of Iron and Steel in Concrete."

The May meeting will be devoted to a discussion of the "Hawley Pumping Plant," by Messrs. Moore and Simpson.

In June the society will make its annual trip, this year to Eastern Washington to inspect the Spokane & Inland Railroad.

Henry R. Stevens, an engineer in the office of Archibald Downie, CE., Seattle, was admitted to membership.

THE SUITABILITY OF CONCRETE AS A MATERIAL FOR BUILDING FORTS AND BATTERIES.

The Russian-Japanese war demonstrated the suitability of concrete as a structural material for building forts and batteries, according to the report of Major Joseph E. Kuhn, Corps of Engineers, U. S. A., an extract of which is presented:

The Russians employed concrete almost exclusively for the masonry work of their forts and batteries. It was largely made of rounded pebbles and much of it was of indifferent quality, far inferior to what would be acceptable in the United States. The cement employed was of a Portland Russian manufacture, and there is no reason to suppose that it would not make a good concrete. Where damaged by artillery fire the concrete was frequently observed to be porous and friable, as if insufficiently compacted. Much of it was also shelly and seamy, no pains having been taken to secure a monolithic structure. No doubt the poor quality of the concrete was largely due to the employment of unskilled Chinese labor which was used in the construction of the defenses.

Notwithstanding the indifferent quality of the concrete, it appears to have answered the purpose well when subjected to bombardment. Shells striking corners or edges naturally chipped out chunks of masonry, but there was not a single instance of a magazine or chamber penetrated along the entire front. There was no evidence of the Russians having employed armored or reinforced concrete in any of their works.

So far as the results at Port Arthur go, concrete will continue to be a most useful material in building forts and bateries, combining, as it does, economy and good resisting qualities.

POWER PLANT FOR JAPAN.

An enterprise involving the investment of millions of American money in Japanese manufacturing and power plants and providing for the construction of an electric plant in Japan with a capacity of 70,000 horsepower, is being perfected by W. E. Guerin, of New York. Mr. Guerin is best known as one of the builders of the Palmer cut-off, now a part of the main line of the Northern Pacific, under the corporate name of the Seattle & San Francisco Railway and Navigation Company.

The purpose of the project is to develop the water power from a mountain lake near Kyoto which is an import city close to Osaka. Both cities are great cotton manufacturing centers. Osaka is an important port as well.

The lake lies at a great elevation above the sea. The plan is to bring the water by means of a tunnel through a mountain, down to a level several hundred feet beneath the lake. The water will be dropped into great concrete penstocks and turned on to turbine-power generating wheels. Power sufficient to operate a great many cotton mills and for electric railroads and light plants for the surrounding cities will be generated.—"Pacific Builder & Engineer."

Bakersfield, Cal.—Another large deal has been consummated by the Monarch Oil Co., controlled by the Spreckels interests in San Francisco, by which the company becomes owner of the entire holdings of the Occidental Oil Co. in the Sunset and Midway oil fields. The Monarch Company is about to commence the construction of the largest oil refineries in the State on the property just acquired. It will be located on the railroad, and work on it is to begin at an early date. Plans and specifications have been drawn, and it is said that capacity of the refinery will be greater than that of any similar plant in California.

REPORT OF SPECIAL COMMITTEE ON ELECTROLYSIS.

Being a Part of the General Report on this Subject to the American Gas Light Association.

The American Water Works Association unanimously adopted, in 1901, the following Report of Special Committee on Electrolysis:

"Your Special Committee on Electrolysis, appointed to make recommendations for the guidance of the Association in dealing with the problem, and to formulate, for your approval, an expression of the attitude of the Association on this question, respectfully begs to submit herewith its report. The following facts are established:

"1. A very large number of mains and service pipes have been already actually destroyed by the stray return currents of electric railways operating under the single-trolley system, many instances of such destruction of pipes by these currents having been reported from practically every city where the single-trolley system has been in use for any considerable length of time. Even where the action is too slow to be immediately discovered, the life of the mains and service pipes is inevitably greatly shortened and their value thereby necessarily proportionately decreased.

"2. In the single-trolley system, no matter how large the capacity of the return feeders, nor how good the bonding of the rails, and even when the continuous rail is used, some electric current will, under the law of divided circuits, flow along the water pipes, the amount of this current bearing the same proportion to the total current used, that the conductivity of the return path of which the water pipes form a part bears to the total conductivity of all the return paths offered to the current. As neither the rails nor the pipes can practically be insulated from the soil in which they are laid, the proportion of current conveyed by the pipes is considerable, even with the best track bondage known to modern science, including the welded joint.

"3. The electric current, once on the pipes, must leave them to return to its source, the generator, and wherever the current leaves the pipes to pass through the soil, the pipes are damaged.

"4. Electrolysis also results from differences in potential between water pipes and any other underground metal conductor, such as gas pipes, and as long as the return current is not entirely removed from the earth, such action will continue.

"5. The extent of the electrolytic injury at any point is directly proportionate to the number of amperes of current leaving the pipe. The smallest measurable difference of potential is sufficient to produce electrolysis.

"6. A cast-iron water main is not a continuous electric conductor, and its joints offer very much higher resistance than an equal length of the plain pipe.

"7. The inevitable effect of any resistance at the joints is to cause a part of the current carried on the pipes to be shunted around the joint, either through the soil on the outside or through the water on the inside, or by both paths.

"8. Wherever the current leaves the pipe to pass around the joint, either outside or inside, or both, the pipe is injured. The action of a fraction of an ampere flowing around successive joints will in time do great aggregate damage to any cast-iron main on which it flows.

"Your committee is convinced, after careful consideration of reliable data on the subject, that there is no known practical method by which owners of underground pipes can protect them against electrolytic injury from single-trolley currents, but that there are two methods of operating electric railways by which the return currents can be kept out of the ground; namely, the conduit system, as in use in New York City and in Washington, D. C., and the double, overhead trolley system, operated in Cincinnati, O., and on suburban lines in the District of Columbia.

"The conduit system is more expensive to construct, and is peculiarly adapted to the larger cities. The first cost of installing a double-trolley system would be a little greater than that of a single-trolley system for the same service; while the cost of converting an existing single-trolley system to a double-trolley system would be trifling, as compared with the enormous interests endangered by the single-trolley current.

"Ten years' experience with the double-trolley in Cincinnati proves that that system is entirely practical, possesses many advantages over the single-trolley, is more economical in operation and maintenance, and that it completely stops the injury to the pipes.

"Your committee, therefore, respectfully makes the following recommendations:

"1. Street railway companies should be compelled, as are electric light companies, and all other electric power companies, to provide a complete metallic circuit for their current, absolutely insulated from the rails and ground. This will keep the return currents out of the ground and off the pipes, and can be accomplished either by the conduit system or by the double, overhead trolley system.

"2. No connections by which a current is carried to the pipe, or induced to flow thereon, should be allowed from pipes to rails, or to other return conductors; and no other alleged remedy which permits the mains to carry any portion of the return current should be countenanced by those in charge of waterworks plants. Even the failure to prohibit or to protest against such connections might be construed by law to be a tacit consent on the part of the waterworks management to use the pipes as conductors, and might relieve the electric railway company from responsibility for the injury which would inevitably result if the mains were allowed to convey current."

New York Copper Prices.

The following were the quotations for copper futures in the regular market on the dates given:

1907	Lake Cents per lb.	Electrolytic Cents per lb.
Feb. 15	25½	25 @25¼
Feb. 21	25½	25 @25¼
Mar. 1	25½@26	25 @25¼
Mar. 8	26 @26½	25¼@25½
Mar. 15	26 @26½	26 @26¼

Comparison with prices last year:

1906	Lake Cents per lb	Electrolytic Cents per lb.
Feb. 15	18½@18¾	18 @18½
Feb. 21	18½@18¾	18½
Mar. 1	18½@18¾	18¼@18½
Mar. 8	18¾	18½
Mar. 15	18¾	18½

The most important recent business was the sale of some millions of pounds of copper by the Calumet & Hecla Company at the tip-top prices of 26½ for April and 26 for May and June deliveries. It was something of a surprise to the trade that the sellers of this particular brand should decide to put two different prices on the copper disposed of in the business alluded to, and the fact was regarded as a determination of the parties of the first part to lead manufacturers to properly appreciate the luxury of a fancy article. Since these transactions the entire market has hardened, and other brands have advanced from ¼ to ½ cent per pound.

INDUSTRIAL

NEW TYPES OF PORTABLE AND STATIONARY AIR COMPRESSORS.

The rapidly increasing applications of compressed air in industrial manufacturing plants in private institutions, power plants and car barns has given quite an impetus to the manufacture of electrically driven air compressors which are self-contained and conveniently taken to the place where the compressed air is utilized.

The number of applications which can be made of air power are too numerous to permit of enumeration, but it suffices to say that in all industrial operations such as drilling, riveting and chipping work on metals, compressed air tools can be more advantageously employed than purely manual or mechanical operated devices. In car barns of electric railway companies or at the terminal houses of steam railways compressed air is highly convenient and effectual as a means of thoroughly freeing armature coils and all parts of the electrical apparatus and car from dirt and dust. In power houses and sub-stations compressed air offers many advantages in the way of convenience, adaptability and thoroughness as a medium for blowing out dust from generator coils, field magnets and commutators. In automobile garages the use of compressed air is especially advantageous as the most convenient, quickest and easiest method of inflating tires, cleaning dust from every nook and cranny of cushions, upholstered seats, running gear, etc. The extreme simplicity, flexibility, cleanliness and reliability of air as a source of power cannot be surpassed and is coming to be better recognized.

To satisfy the demand for a compact, self-contained and stoutly constructed portable compressor outfit, the National Brake and Electric Company has designed and manufactured a type which will appeal to purchasers desiring a convenient and durable appliance at a minimum cost, consistent with high-grade apparatus.

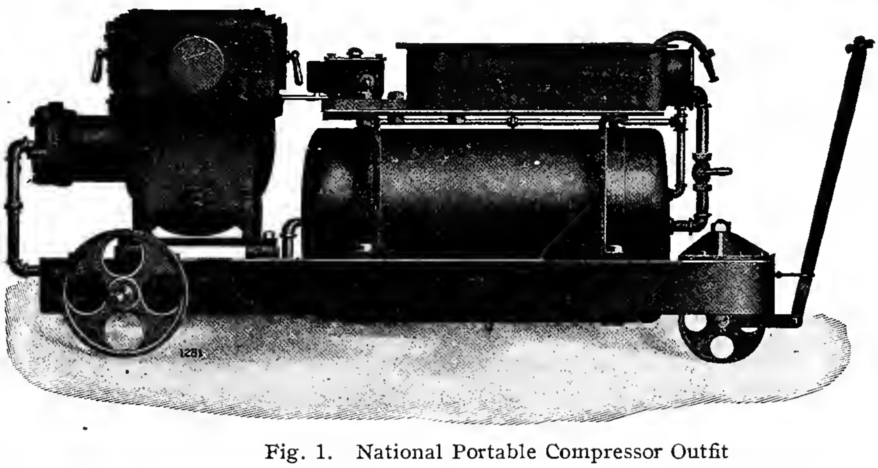

Fig. 1. National Portable Compressor Outfit

The outfit comprises a compressor, an automatic type "N" governor and necessary piping, an air gauge and reservoirs, and a combined switch and fuse, the whole being mounted on a substantial angle iron frame supported on wheels. The front wheel is hung in a pivoted fork made of cast steel, the outfit being drawn around by means of a wrought iron tongue.

One of the greatest advantages in the design of National portable air compressors is the exceptionally small width of the outfit which is gained by such a disposition of the parts that there is no waste of space on the truck. The width of the outfit over all is but 29¾ inches, which readily permits it to be taken through doors and openings in shops and factories of much smaller size than the average. In crowded mills and factories the National portable air-compressor outfits may be easily taken through spaces where other types of such apparatus would be wholly impracticable.

The Air Compressor.

The air compressor furnished with the portable outfit is the National Standard New and Improved, in which one of the many distinctive features is the construction of motor and compressor as entirely separate and self-contained units. When the two parts are assembled a most compact and rigid compressor unit is produced. The crank chamber cover and the motor base are separated by a half-inch air space, which acts as an insulator of the heat radiated by the compressor. Thus the motor is always cool in operation. This separate cover gives the required bracing and stiffening for the crank chamber casting.

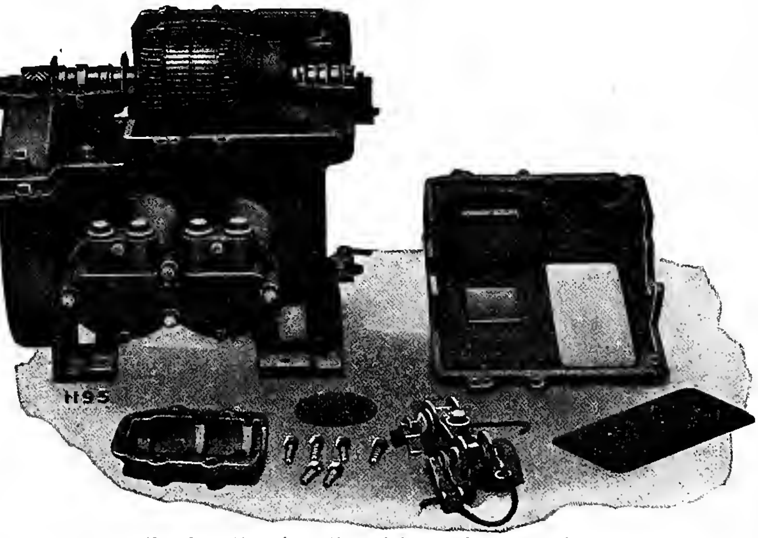

Fig. 2. Showing Simplicity and Accessibility

The simplicity of design and construction, as well as the accessibility of all parts likely to need attention are illustrated in Figure 2. The crank shaft is fitted with a third bearing in the center, which, in addition to supporting and strengthening it at its weakest point, eliminates all tendency of the shaft to fracture at the center.

All bearing and working parts of the compressor are very thoroughly and effectively lubricated by means of the standard splash system of oiling. The gear and crank are enclosed in a bath of oil which is splashed over all the operating parts of the compressor.

The valve head is constructed with the discharge valve toward the center and the suction valve toward the outside of the head. The discharge pipe runs straight out from the valve head

to the main reservoir, thus dispensing with the necessity of attaching elbows, etc. The suction has two openings, one on either side of the valve head; either or both can be used.

The Motor.

The motor is a standard National four-pole enclosed type. The frame of the motor is a cast steel housing, well proportioned in metal and accurately finished. It is made in one piece and extended in both directions to form a box-shaped covering for the armature and field coils. The pole pieces are an integral part of the frame with well machined pole faces. Particular attention is invited to the brush gear primarily in the matter of insulation. The external leakage surface of the insulation is $1\frac{1}{4}$ inches, compared with the $\frac{3}{8}$ or $\frac{1}{2}$-inch insulation provided by most manufacturers, absolutely insures immunity from insulation troubles. An insulating shield is provided between the bearing and commutator to prevent all possibility of the current flashing over between the two, due to wide fluctuations of voltage on the supply circuit.

The Governor.

The governor, supplied with portable compressor outfits, is a standard Type "N" oil pneumatic, which has fully demonstrated its absolute reliability and adaptability to the hardest kind of service.

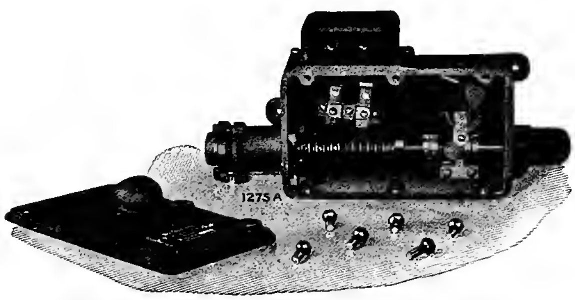

Fig. 3. Governor with Cover Removed, Showing Details and Simplicity of Construction

The governor with cover removed is shown in Figure 3. The governor is extremely simple in design, has few working parts and occupies very little space. The essential features of the device are a cylinder, one and one-fourth inches in diameter which is connected direct to the main reservoir; a piston working in the cylinder is acted upon on one side by the pressure of the air in the main reservoir and on the other by the expansion of the operating spring. Movement of the piston throws a toggle joint over its center and causes a hammer to strike a switch-arm which makes or breaks the circuit to the air pump. The working parts are all contained in a box filled with oil which not only serves to keep the working parts lubricated but also extinguishes the arc caused by the breaking of the circuit. A tightly-fitting cover prevents leakage of oil.

With the portable outfits there is also furnished all necessary adjuncts, including a safety valve, an air gauge, piping and a very substantial and conveniently arranged hose container large enough to hold from 75 to 100 feet of hose.

Type "L" Water-jacketed Stationary Compressors.

These compressors are identical in every respect with the compressors just described, except that provision is made for a circulation of water around the cylinders and heads, keeping these parts at a minimum temperature and permitting the machines to be operated continuously.

All working parts of the compressor operate in a bath of oil. The other parts are automatically and continuously lubricated in a most thorough manner.

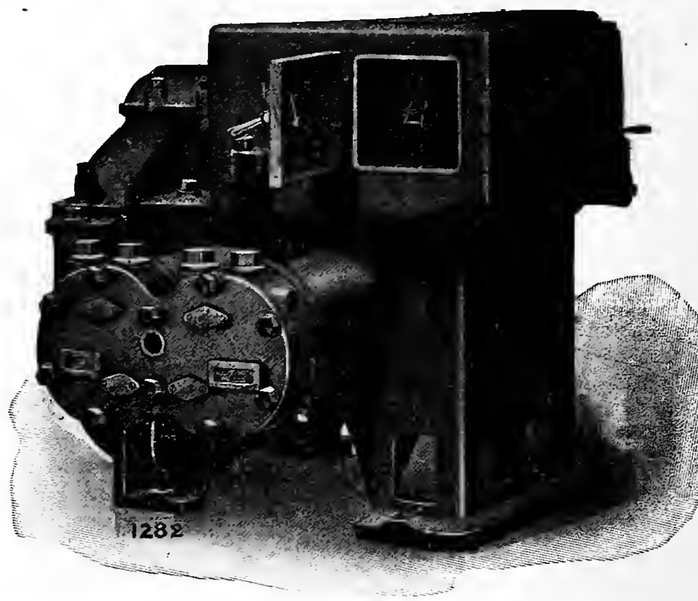

Fig. 4. Type "L" Water Jacket Compressor

With the water-jacketed types there is furnished a water governor which automatically cuts off the circulation of water as soon as the compressor is shut down. These governors are very simple and reliable in operation, and eliminate the possible neglect to turn the water off after stopping the machine, and in a like manner the water is admitted to the cylinders and heads when the compressor is started up.

Although the working parts of the machine are entirely enclosed and protected from injury, accessibility was carefully considered in the design, and every part can be quickly and easily inspected.

The portable compressor outfits are made in capacities of from eleven to fifty cubic feet of free air per minute; the water jacketed types are made in sizes ranging from twelve to thirty-five cubic feet of free air per minute. Detailed information on National Portable and Stationary Compressor Outfits is given in Bulletin 374, which will be sent upon request to the National Brake & Electric Company, Milwaukee, Wis.

ELECTRICAL MACHINERY IN SOUTHERN CALIFORNIA.

The engineering projects which have been undertaken on the Pacific Coast have almost invariably been carried out on a large scale. Long-distance electrical power transmissions, hydraulic power developments, or whatever the proposition which has been planned, have usually been brought to completion with such a degree of success that this section has come to stand as a pioneer in many kinds of engineering enterprises.

The section of country about Los Angeles, in the southern portion of the State of California, has assumed a particular interest in engineering matters from the large number of great development enterprises which have centered there. The city of Los Angeles itself enjoys the fruits of many of the engineering achievements which have been realized in its vicinity, not the least important of which is the supplying of its electrical service, light, power and traction facilities.

The Los Angeles Interurban Railway Company is one of five or six transportation companies forming what is known as the "Huntington Street Railway and Interurban System" in the Los Angeles district. This company and its associate companies have been undergoing rapid growth and extensions. The Huntington roads ramify Los Angeles County and those contiguous to it. Their power is taken from sub-stations distributed over the territory described. The number and capacity of these stations is constantly being increased, according to the direction of travel.

The motor-generators, etc., installed in these sub-stations, which were sufficiently large eighteen months or two years ago, are now being replaced by larger and more powerful machines, while the displaced smaller units are pushed further out on the lines.

Three Allis-Chalmers 1000 K. W. induction motor-generator sets, whose generators have a rated capacity of 1000 K. W. and motors 1500 K. W., have recently been ordered. In the course of time, if the traffic continues to warrant, the sub-stations which are now being equipped will either be increased in capacity by the addition of more 1000 K. W. units or these machines will in their turn be pushed further out and replaced by still larger units.

It is interesting to note that the power for the Huntington roads is taken from at least eight separate generating stations, both steam and water driven, all focusing in Los Angeles and being separated, in some cases, approximately 200 miles from each other. All of these stations work in synchronism.

The original power house for the system, which has been added to repeatedly in the growth of the enterprise, will doubtless be operated in the course of time as an auxiliary station. Among other units there are already installed in it three Allis-Chalmers 1500 kilowatt, 120 revolutions per minute, 50 cycle, 2300-volt engine-type generators, all driven by cross compound engines and constituting the latest addition to the equipment.

A NEW REFLECTOR-STALACTITE.

The Holophane Company, Sales Department, have recently placed on the market a new Reflector-Stalactite similar in construction and application to their well-known Pagoda ball which has been used so largely in the public buildings of this country.

Figure 1 shows one of these Reflector-Stalactites, the

Fig. 1

upper part consisting of scientific prisms, while the lower part is of ground glass, the whole being made in one piece, thereby uniting the effects of the frosted glass with the efficiency of

Fig. 2

Holophane prisms. This globe is made for a 3¼ inch holder, has a width of 6 inches and a height of 7¾ inches.

Figure 2 shows a similar type of Reflector-Stalactite having exactly the same dimensions in regard to holder and width, but having a height of 10 inches.

The globes in point of efficiency easily achieve the high standard set by the Holophane System. When lighted up, the result is very brilliant and altogether adds greatly to the artistic features of any place where used. The ground glass bottoms of these stalactites can be cut in a number of different patterns. In this way the beauties of cut glass are combined with the Holophane System of Illumination. Lamps of from 16 candlepower to 22 candlepower, are recommended for us in these globes.

Full particulars and prices may be had by writing to The Holophane Company, Sales Department, 227 Fulton Street, New York.

A SIMPLE METHOD OF CHARGING STORAGE BATTERIES.

The General Electric Company exhibited at the Automobile Show in San Francisco, February 18th to 25th, inclusive, two designs of mercury arc rectifier sets, a simple and economical device for transforming alternating current into direct current for charging automobile storage batteries.

Owners of electric machines will be especially interested in the standard charging panel for charging their storage cells. This outfit is shown in Fig. 1. Ordinarily the only circuit available at the home garage is that carrying the lighting current, which is almost universally an alternating current of electricity and not suitable for charging automobile cells.

The mercury arc rectifier changes this alternating into direct current economically and at the lowest initial cost.

The apparatus consists of a glass tube, the rectifier, mounted compactly on a Vermont marble panel with the necessary instruments and switches. The outfit is simple and reliable, and requires no attention. It takes up a very little space in the garage, and is ready for use when the switches are closed. No skilled attention is required, and the outfit can be operated by any person of ordinary intelligence.

A second outfit for charging ignition batteries is particularly valuable to owners of gasoline machines. This outfit is shown in Fig. 2. It is well known that storage cells are the most reliable type of battery for ignition work, but the inconvenience of having to take them to a public station to be charged, has not fostered their use.

The General Electric Company's rectifier set was designed to meet these conditions, and any one may conveniently charge a four-cell battery at a cost not exceeding twenty-five cents, using the direct current transformed by the rectifier from the lighting circuit.

The outfit is a miniature of the larger rectifier set, and has all its advantages.

ELECTRICITY IN ALASKA COPPER MINING.

The first practical application of electricity in Alaska copper mining has been inaugurated by the Reynolds-Alaska Development Company in the installation of a complete electrical equipment on La Touche-Iron Mountain mine on Prince William Sound. A waterfall capable of generating upward of a thousand horsepower has been harnessed, and the entire capacity eventually will be utilized.

The present equipment consists of a Pelton water wheel, two fifty-kilowatt Westinghouse generators, an electric hoist and pump, and four Temple pneumatic electric drills. The plant was put in operation early in November, and has since been running night and day, giving entire satisfaction. Thousands of dollars will be saved annually on the fuel item alone, and this, of course, means the cheaper production of copper.

Hood River, Ore.—Bids will be received by C. E. Markham until April 5 for the construction of Rorden and Dead Point Ditch.

NEWS NOTES

TELEPHONES AND TELEGRAPHS.

Sunnyside, Wash.—The Farmers Independent Telephone Association has installed a switchboard here.

Puyallup, Wash.—The Tacoma Industrial Company will erect a large brick building on South Main Street for their electric plant.

Spokane, Wash.—The Washington Water Power Company has increased its capital stock from $5,000,000 to $10,000,000.

Seattle.—The office of the United States Signal Corps in the Walker block will be moved to the new Arcade building when it is completed.

Tacoma.—The Northwestern Long Distance Telephone Company, of California, has appointed Roscoe Howard, of this city, as state agent.

Pullman, Wash.—The Breeze-Burgan Telephone Company, capital $3,000, has been incorporated by S. H. Breeze, Ed R. Young and others.

Puyallup, Wash.—The Pacific Telephone and Telegraph Company are reconstructing the entire Puyallup telephone system.

Seattle, Wash.—Superintendent Youngs, of the lighting department, states that work will begin at once on the proposed extensions to the system.

Indian Head, Sask.—The city is preparing to spend $25,000 on improvements to the electric lighting system. T. E. Donnely, mayor.

Portland, Ore.—The Pacific Light & Power Company, capital $50,000, has been incorporated by C. P. Houston, D. A. Houston and Alex. Sweek.

Meadows, Ida.—B. A. Chisholm and Edward Goodman are interested in the construction of an electric power plant at the falls of the Little Salmon, sixteen miles below here.

Spokane, Wash.—The Washington Water Power Company will lay 400,000 feet of underground ducts for its light and power wires the coming summer.

McCammon, Idaho.—A telephone company has been organized here with a capital of $10,000. A local system will be established connecting all nearby towns.

Olympia, Wash.—The Nesqually Power Company, of Tacoma, will construct a big electric power plant in Thurston County, on the upper waters of the Nesqually River.

Vancouver, B. C.—A contract has been awarded by the B. C. Tel. Co. to Miss E. W. Johnson for the erection of a new pole line between this city and Port Moody.

Richmond Beach, Wash.—The Richmond Beach Telephone and Power Company, capital $15,000, has been incorporated by Henry Parry and Ralph P. St. John.

Gig Harbor, Wash.—At Gig Harbor and Springfield, about fifty miles of country telephone line will be constructed, and a six-pair cable laid across to Point Defiance.

Tacoma.—The Pacific Telephone and Telegraph Company have about completed the cut over to Central Energy, at which work a large force has been engaged for the past several months.

Seattle, Wash.—Six wireless telegraph stations are to be established in Alaska. The stations are to be located at Nome, Fort Gibbons, Circle City, Fairbanks, Valdez and Sitka.

Renton, Wash.—The Independent Telephone Company will be ready to give service at this point soon. A 160 line Stromberg-Carlson common battery board and other central station equipment has arrived and is now being placed.

San Francisco, Cal.—Market Street is to be torn up from Twelfth Street to the ferry. The City Electric Company has notified the Board of Public Works of its intention to begin this week putting in a conduit for its wires along the thoroughfare.

Richmond Beach, Wash.—McGillivray & Piepot, Seattle, have been awarded the contract to construct about forty miles of telephone circuit for the Richmond Beaech Telephone and Power Company. The specifications call for standard construction, thirty-five poles to the mile.

Tacoma, Wash.—G. D. Grant has made application to the county commissioners for the right to construct and operate a system of waterworks, sewerage, gas pipes and electric light lines along and over Lake City Boulevard in Sections 9 and 16, Township 19 N., R. 2 E., W. M.

Great Falls, Mont.—At a largely attended and thoroughly representative meeting of the citizens here resolutions were adopted condemning the Rocky Mountain Bell Telephone Company for its alleged inefficient service, exorbitant rates and unfair wages paid to operators, who are now on strike.

Wallace, Ida.—G. Scott Anderson is organizing a company to be known as the Inland Power Company, capital $300,000. The incorporators are Stephen P. Wright, of Butte, Mont.; G. Scott Anderson, of this place; Maurice W. Bacon, William H. Hall, of Butte, Mont., and James J. Maloney, of Chicago.

San Francisco, Cal.—J. V. O'Brien, the manager of the Western Union office of this city, was married last week to Miss Ella Battles. Both have been connected many years with the company, their acquaintance dating from the time when they worked together as operators. Mr. O'Brien has risen from the position of messenger boy to that of manager.

Los Angeles, Cal.—A. H. F. Schaar, an electrical engineer of this place, has invented an instrument called the teleautoprint, with a keyboard like a typewriter, which both sends and receives messages, printing them automatically. It turns out a sheet resembling a typewritten message, no operator being necessary to do the work of receiving. The United States Wireless Printing Telegraph Company has been incorporated to handle the invention and put it on the market. The corporation is capitalized at $10,000,000. As soon as arrangements can be perfected a factory will be built.

San Francisco, Cal.—The arbitration committee which is to pass on the differences between the Southern Pacific and the Order of Railway Telegraphers is holding sessions in this city and will consider the subjects under discussion for two weeks or more. There are three points at issue: The contention of the men that train despatchers belong to the order and are subject to the rules of that body. The company holds a contrary position, arguing that the despatcher is an official of the company, as he gives orders to the telegraphers, signs the name of the division superintendent, and is a commanding officer.

The second point is "seniority." The men assert that the company should give the oldest man in the service a good station when a vacancy occurs. The company protests that

it wants to be able to select its representatives from any branch of the service it chooses, not confining its choice to telegraphers.

The last point is the question of hours and wages. The men want an eight-hour day and an increase in the present schedule. This, it is said, can be adjusted easily.

Oakland, Cal.—Extension of the block signal system out of Oakland is planned by the Southern Pacific Company and all the work of equipping the lines with the most approved form of safety devices is being carried out as rapidly as men and material can be secured for that purpose. The main lines, over which the heaviest traffic is sent, will be the first to receive attention, after which the other branches will be provided with apparatus, until within a few years the entire Southern Pacific will be operated in the most approved manner and with the risks attending human fallibility reduced to a minimum. Arrangements have been made for the equipping of the route from Elmhurst to Santa Clara, from Elmhurst to Niles, and from Niles to San Jose. From Niles eastward the block signals will be placed along the track as far as Tracy. At present considerable material has arrived at Niles and with the coming of favorable weather gangs will be put on with orders to rush the work of erection.

ILLUMINATION.

Yuma, Ariz.—An ordinance has been adopted granting to Seth Hartley permitting him to construct and maintain a gas plant for the city.

Azusa, Cal.—William Gard, representing a company of Pasadena investors, is in town looking for a suitable location for a gas plant. It is his intention to install a plant that will cost $20,000.

Santa Fe, N. M.—Superintendent Arthur Trelford, of the Territorial Penetentiary, states that an electric light and power plant for that institution could be established for about $15,000. The subject is now being brought to public attention by the introduction and passage of a bill in the House of Representatives.

Folsom, Cal.—Some months ago the supervisors let a contract for lighting the streets of the city, but the work of installing the lights has been delayed because it was impossible to get some of the fixtures. These have been received and the contractor expects to have everything in working order within a week.

Corona, Cal.—A petition has been presented to the Town Trustees asking for better street lighting. The matter has been referred to the City Department with the request that the committee confer with the electric light company to ascertain the probable cost of a system of incandescent lights such as is asked for in the petition.

Kelseyville, Cal.—An ordinance has been passed by the Board of Supervisors granting to the Lake County Electric Power Company the franchise and privilege of erecting and maintaining poles and stringing and maintaining wires for the purpose of transmitting and distributing electricity for the purpose of producing light, heat and power along certain streets in the county.

Oakland, Cal.—By the collision of an oil barge with the Oakland Gas, Light and Heat Co.'s wharf last week an electric salt water pumping plant was seriously disabled, causing a great reduction of gas pressure. Lack of water temporarily crippled the gas works, and the auxiliary service could not be used as it was undergoing repairs. An official complaint has been lodged by Mayor Mott against the company.

Alameda, Cal.—Superintendent Joseph B. Kahn of the Municipal Electric Light Department, has discovered that the wire supplying lighting current to seventy-five incandescent lamps in the houses of the Bay Shore Athletic Club, at the south end of Ninth Street, were tapped before the current entered the meter, and that as a consequence the city has been defrauded out of payment for the current. How long this condition of affairs has existed is not known, and it cannot be discovered who did the wire tapping. Kahn has ordered the supply of juice to be cut off from the club house, and it is probable that the matter will be investigated.

Napa, Cal.—The Napa Valley Power Co. has filed articles of incorporation, the project being, not as was first believed, an extension of the Bay Counties Power Co. from Napa, but an effort on the part of the Calistoga plant to extend its line southward and gain control of the entire valley north of Napa. The plant of the Calistoga Electric and Power Co. has been purchased by the new company, which has Harry M. Pitman, T. B. Pitman and G. S. Cutler for its directors. The new company is making a hard fight for the privilege of supplying St. Helena with light and power. The St. Helena Board of Trustees has again refused the offer of the St. Helena Gas and Electric Co. to pay a twenty-five per cent. raise for service to 12:30 a. m. at a meeting last week, and Mr. Pitman assured the Board that his company would guarantee a twenty-four hour service at a far cheaper rate. He has secured the consent of the Board to advertise for bids for the sale of an electric light franchise. The franchise will be put up in about thirty days, and Mr. Pitman promises to have current running into the town ready to be used within a month after that. The local plant uses oil to generate its power, and is owned principally by local residents.

TRANSPORTATION.

Merced, Cal.—Work is being rushed on the Yosemite Valley Railroad by a force of 1,500 men. The road is now being built from Merced to the park line, and the track is completed to Fox Creek within fourteen miles of the terminus. By the end of April the road will be ready to take passengers to the park.

Woodland, Cal.—There is a rumor about that something will soon be done in the matter of the electric road franchises secured by Captain Forsman for the construction of a line from Capay Valley to Elkhorn. It is asserted that a well-known railroad builder has become interested in the project and that he recently investigated the situation.

Martinez, Cal.—The East Shore and Suburban Electric road has commenced operations on the extension of its line to Point Orient. The extension has been talked of for months. It is expected that the road will be in operation within ninety days. The line will run past the quarries of the San Pablo Quarry Co., the winery of the California Wine Association and the can factory operated at Point Orient by the Standard Oil Co.

San Francisco, Cal.—Negotiations for the transfer of the holdings of the Eureka Transit Company were concluded last week and the control passed to George Heazelton of this city. The road formerly belonged to George Bull and associates. At present the line is twelve miles long. The plans of the new owner include an extension of fourteen miles around Humboldt Bay to Arcata. Later, if feasible, another extension will be built crossing Eel River at Scotia and running up to Ferndale.

Santa Cruz, Cal.—G. C. Pratchner, of the firm of Pratchner & Chadwick, has returned home after making a tour of inspection on foot of the Ocean Shore Railway between San Francisco and Halfmoon Bay. Contracts have now been let for all the roadbed between San Francisco and Halfmoon Bay, and this part of the road is now being rushed to

the exclusion of the road south of Halfmoon Bay, as it is planned to have trains running between these points by July 1st.

Redwood City, Cal.—The franchise owned by Clark & Bowie has been sold to the California Rapid Transit Co. The Board of Superivsors of this county sold two franchises to Clark & Bowie, one for an electric railroad to run from San Mateo to Halfmoon Bay and the other to operate a steam railroad. Very little work has been done on either. Clark and Bowie have been cited to appear before the Trustees and show cause why the franchises should not be revoked, and they have now disposed of them to the transit company.

Stockton, Cal.—A syndicate of Alaskan mining men, backed by a capital of $3,000,000, will commence at once the construction of an air line electric road from Stockton to Byron direct and from the latter point feeders to the Brentwood district on the north and to Livermore on the south. Byron Hot Springs, Bethany, and Herdlyn Station will be tapped and branch lines will be run throughout the southern end of the county. Double-track steel bridges will be built over the San Joaquin, Old and Middle Rivers, and at Old River large docks will be constructed, from which it is proposed to ship grain and hay and other produce to San Francisco. From the junction of the line and Old River a branch will be run to Oakley and Knightsen, and possibly to Antioch.

Berkeley, Cal.—Purchases of land at the stone culvert, which crosses Cardonices Creek at the point where Hopkins and Grove Streets meet, by persons acting for the San Francisco, Oakland and San Jose Railway have been followed by the report that the Key Route depot in North Berkeley will be established at that point. The route along Walnut Street has apparently been abandoned and the Sacramento Street line been closed as the means of access to the northern part of the city. The new Sacramento Street line will cut off from Fortieth Street, in Oakland, at California Street, and will come up California to a point near University Avenue, where the line will swing over to Sacramento Street.

TRANSMISSION.

Compton, Cal.—An ordinance has been adopted granting to G. R. Fulton the right to maintain poles and wires and other apparatus for use in furnishing electrical energy for lighting and heating purposes along the streets of Compton.

Folsom, Cal.—Wm. Muir, of Sacramento, has men at work building a dam below Colfax Bridge, on the North Fork of the American River. He and a party interested with him are going to put in a $500,000 electric plant this summer at the junction of the north and middle forks.

Guadalajara, Mexico—With a view of viewing the demand for additional election power in the Guanajuato mining district, the Guanajuato Power and Electric Company is taking up additional water rights along the Duero River in the State of Michoacan, and a second hydro-electric plant will be installed.

Los Angeles, Cal.—The first electric power plant on the Owens River aqueduct was definitely decided upon March 9th, and specifications were sent out for immediate installation. This power plant will be located at the mouth of one of the little streams at the intake, and will be put in operation at once, furnishing electricity to drive an electric dredger.

Quincy, Plumas Co., Cal.—J. W. Goodwin and associates, it is given out here, plan a big reservoir in Humbug Valley for power purposes. They recently acquired the Miller properties in that section for the sum of $90,000 and also stock in the Cataract Gold Mining Co., thus gaining control of a suitable river site on the North Fork of the Feather River.

Red Bluff, Cal.—There is again considerable activity displayed in obtaining water rights and power sites on Mill Creek, in the southern part of Tehama county. There are several opposing parties who have already filed on water rights there, and now come other parties, said to represent the Western Power Company, who have filed two claims for 10,000 miners' inches each to the waters of Mill Creek.

Oroville, Cal.—Brown, Wilson & Company are engaged in the development of great electric power plants on the north fork of the Feather River. The company proposes eventually to develop 420,000 horse-power of electrical energy from the stream. When the route of the Western Pacific Railroad, which follows the stream nearly to its source, was definitely settled, the properties of the mining company were acquired by the Great Western Power Company. On the bank of the river 525 feet below the outlet of a tunnel at Great Bend a power plant is being built. In this will be installed the largest electrical units ever constructed. The company contemplates much development in Plumas County at a point fifty miles north of the Great Bend plant.

Stockton, Cal.—Excavation for the foundations of the American River Electric Company's steam plant in the western part of town has been stopped by the high water, but it will be resumed before long. The object of building the plant is to have a reserve which can be thrown into use instantly in case anything should happen to the current from the mountains. The building will front eighty feet on Madison street and sixty-one feet on Lindsay. It will be fireproof throughout, the only materials used being steel and reinforced concrete. Electricity will be generated by a generator directly connected to a 3,000 horse-power Curtis turbine engine driven by steam from the boilers using oil fuel. The interior equipment of the structure will include a 40-ton crane.

Los Angeles, Cal.—The Edison Electric Co. has plans for the development of additional power. Its Kern River plant is nearing completion, and when it is in operation the company will have approximately 55,000 horsepower. Even this large amount will not be sufficient, because of the increased volume of business. At a meeting of the stockholders recently it was decided to add $1,200,000 to the capital, making the entire amount $11,200,000. This increase is necessary because of the volume of work being undertaken. The earnings of the company last year increased $460,000, while the expenses increased $200,000. The electric lighting business has increased twenty-seven per cent., the power business forty-five per cent., and the fuel business forty-nine per cent. The company proposes to place on the market 12,000 shares of common stock at $75.00 a share. It is the intention of the board of directors to make the first payment of dividends on August 15, 1907.

Cottonwood, Cal.—The seventy-five-foot false dam across Battle Creek, at the diversion point for the ditch that is to convey the water to the Northern California Power Company's power house site in Horseshoe Bend, is completed. The company has a force of seventy-five men at work. The false dam has been built just above where the permanent dam of stone will be constructed. The purpose of the false dam is to back up Battle Creek and turn the water to one side in a ditch, leaving the creek dry, so that work on the stone dam can be commenced on bedrock. The stone dam will be a work of great magnitude, being 133 feet high and 650 feet wide at the top.

There will be required 100,000 cubic yards of masonry, and the cost is estimated at $100,000. The power house site is five miles down the stream from the dam. The station will be capable of furnishing 15,000 horse-power. When all the company's proposed and existing plants are working they will command 25,000 horsepower.

INCORPORATIONS.

Tacoma, Wash.—The Tacoma Railway & Power Company will improve its Steilacoom line at once.

Seattle, Wash.—The Seattle Electric Company was granted a franchise on Prefontaine Place.

Palouse, Wash.—The Inland Electric Railway Company is building a depot here at a cost of $18,000.

Helena, Mont.—The Helena & Butte Electric Railroad Company has been incorporated with a capital of $3,000,000.

Eureka, Cal.—Certificate of change of principal place from this town to San Francisco has been filed by the Humboldt Transit Company.

San Francisco, Cal.—The Davenport Light and Power Company has been incorporated here. The capital stock is $10,000, shares $10 each.

Santa Barbara, Cal.—The Summit City Oil Company has been incorporated here with a capital stock of $500,000, of which $35 has been subscribed. Shares are $1 each.

Medford, Ore.—The Oregon Development Company will build an electric railway connecting Medford, Ashland, Jacksonville and Central Point.

Mt. Vernon, Wash.—Commissioners granted a franchise to the Superior Portland Cement Company to build an electric railway along the county road in sections 2, 3, 10 and 11, township 35, north of range 8.

North Yakima, Wash.—County Commissioners granted a franchise to the Yakima Inter-Valley Traction Company over county roads. The line runs south to Zillah, a distance of twenty-four miles.

Oregon City, Ore.—The Oregon City, Beaver Creek & Molalla Railway Company has been incorporated with a capital of $100,000, by Grant B. Dimick, Thomas T. Ryan and J. W. Sherwood, of Portland.

Red Bluff, Cal.—The Mill Creek Power Company has been incorporated by J. A. Whitehead, C. S. Barnes, F. R. Eldridge, M. O. Ballard and J. T. Cameron. The capital stock is $100,000, of which $1,000 has been subscribed.

Fresno, Cal.—With a capital stock of $25,000, the Central California Land and Water Company has been incorporated; $20,000 has been subscribed by C. M. Chalup, W. H. Peterson, C. E. Hamilton, H. C. Katze, and J. F. Summers.

Santa Barbara, Cal.—The Mountain Oil Company has been incorporated here with a capital stock of $500,000, shares at $1 each. The directors are H. A. Heller, J. Kolboth, C. P. Baird, J. Martin, J. B. Tait, and W. L. Leslie.

San Francisco, Cal.—With a capital stock of $1,000,000, the Williams Oil Company has been organized and incorporated by J. M. Wright et al. Fifty shares at $5 each have been taken.

Monrovia, Cal.—The Sierra Madre Telephone Company was incorporated here. The officers elected were W. E. Farnam, president; J. M. Baldwin, vice-president; F. N. Hawes, secretary; J. H. Baldwin, manager.

San Luis Obispo, Cal.—Articles of incorporation have been filed by the Western Pacific Oil Company, which is capitalized at $500,000. The directors are Peter Toggazini, V. H. Woods, E. W. Clark, J. Crocker and A. J. Martin.

Santa Barbara, Cal.—The Valentine Oil Company has just been incorporated with a capital stock of $300,000. The shares are $1 each, and $120 has been subscribed by F. H. Gates, J. P. Jacobs, L. S. Drumm, R. H. and Deane Laughlin.

Ventura, Cal.—The Mupu Oil Company has recently been incorporated here with a capital stock of $1,000,000, shares $1 each. The directors are T. A. and J. H. Slocum and Captain Fernald of Santa Paula, E. L. Jackson and Jas. B. Hanby, of Los Angeles.

Fresno, Cal.—H. E. Huntington is backing the Sierra Nevada Electric Company, recently incorporated here with a capital stock of $1,000,000. Shares sell for $100 each, and $5,000 has been subscribed by H. E. Huntington, W. G. Kerckhoff, A. C. Balch, J. C. Eastwood and F. H. Short.

San Luis Obispo, Cal.—The Hong Kong Oil Company, the promoters of which are V. L. Donati et al, of this city, has been organized in the law offices of Wm. Shipsey. Gin On was elected president; V. L. Donati, secretary, and Andrew Banks, treasurer. The directors of the company are V. L. Donati, W. Ging Fong, Chin Quon, and Lee Hing. The company will commence operations on the property acquired near the Pennsylvania Oil Company No. 8 well.

Reno, Nev.—Ambrose Madden, who has been an employee of the Carson-Truckee project, is the moving spirit in the incorporation of the Tempest Mining Co., for the sum of $200,000 under the laws of the State of Nevada. Associated with him is Paul C. Groth and Attorney Bird, of Fallon, and the property is located two miles southwest of Derby, and twenty-six miles of Reno. The main working shaft is down fifty feet, and will be continued to the 100-foot level, at which point crosscuts will be advanced to the vein.

OIL.

Fresno, Cal.—Secretary Jacob Clark, of the Twenty-eight and Oil City Petroleum Companies, has finished up the work of distributing the funds received from the late sales of the properties to the Standard Oil Company, and has sent to each of the stockholders the amount credited to his shares. It is the intention of the directors, who are the same men, to liquidate the corporations at once, and all new stock is being called in. The fund to be divided between the stockholders in return for giving up their shares is $850,000.

Bakersfield, Cal.—The first of the leases from the independent oil companies of the Kern River field to the Independent Oil Producers' Agency have been filed, although most of the documents were drawn up and acknowledged in 1904 and 1905. The form of the lease is very simple, and it conveys "the exclusive right, during the period herein stated, to bore, drill, mine, excavate and dig for and otherwise develop, collect, and obtain petroleum, asphaltum, bitumen, oil, coal and other minerals in and upon or under" the land described. The leases all run for a period of five years. Those filed so far are from the following companies: Alcides, Amazon, Caloma, East Puente, Euclid, Morton-Ritchie, Lakawanna, W. S. Morton, May, Nevada Consolidated, Potomas, Revenue, Sterling Oil and Development, Vesta, Merrill Crude, and Illinois Crude.

San Francisco, Cal.—Papers were signed last week in the office of Attorney Jesse Lilienthal, in the Flood Building, by which the 7,000-acre ranch of Mahoney Bros., the local contractors, in Santa Barbara County, was transferred to the Southern California Oil Syndicate, a corporation composed of London capitalists and Californa oil men. The price paid was not made public. The property is located two and a half miles south of Santa Ynez, and is in the oil belt. Development will soon be begun on a large scale.

Santa Monica, Cal.—The Santa Monica Oil, Gas and Mining Company is preparing to develop its property six miles northeast of here. A large force of men are building roads to the tract so that lumber and drilling machinery may be delivered.

WATERWORKS.

Hollister, Cal.—Following is the report of the Hollister Water Co.: Value of plant (actual cost), $136,337.69; receipts from the sale of water inside of town limits, $13,144.11; disbursements, $16,156.01, and deficit, $3,011.90.

Manhattan, Nev.—The Home Water Company has been incorporated to supply this camp with water. The mains are now being laid in Main Street. The company obtains its water from wells at the foot of the mountain. A large cement reservoir will be constructed on the top of the mountain to maintain an even supply.

Mountain View, Cal.—At a meeting of the Council recently, C. E. Moore, the city engineer, was presented with the plans and specifications for the proposed water line and steel tower, to replace those destroyed by the earthquake. The pipe line included four and six-inch water mains for Villa Street. The plans were adopted and the clerk instructed to publish a call for sealed bids.

Stockton, Cal.—Superintendent Hall, of the Stockton Water Company, submits to the public the following statement in relation to fixing the rates for the ensuing year: "The water company, by the laws the State, is entitled to earn, over and above its operating expenses, an amount not under six per cent. nor over eighteen per cent. on its investment. Out of this earning it pays bond interest, and if there is anything over it may go to dividends for the stockholders to be put back into improvements. Owing to the low water rates allowed in Stockton the water company has not earned, during the last ten years, over two or three per cent. on its investment. It has, during that time, not only put back all its earnings into improvements, but an additional amount of $132,000. Its net revenue during the above period has been barely enough to pay its bond interest."

ENGINEERING.

Kalispell, Mont.—Plans are being prepared by the Flathead Valley Water Power Co. for improvements to the Big Fork Electric Power & Light Co. to cost $50,000.

Thorp, Wash.—The Tacnum Water Company, capital $150,000, has been incorporated by David T. Edwards, Fremont L. Calkins, C. A. Splawn and others.

Portland, Ore.—Sealed bids will be received at the office of the U. S. reclamation service until April 15 for the excavation of the Keno Canal near Klamath Falls involving about 80,000 cubic yards of earth and rock excavation.

Medford, Ore.—The Sterling Mining Co. has completed a survey for a twenty-one-mile ditch. The work will cost $50,000 and furnish water for 7,000 acres. The work is to let by contract, to be completed by March 1, 1908.

Bellingham, Wash.—Bellingham citizens will meet Congressman W. E. Humphrey and Major Chittenden, of the United States Engineering Corps, in this city April 4th, to discuss desired improvements in Bellingham Bay.

Salem, Ore.—The Josephine-Klamath Company, capital $1,000,000, has been incorporated by F. William Russ, F. D. Smith and R. C. Maxwell. The company will engage in agricultural, mining and irrigation work in the counties of Josephine and Klamath.

Payette, Ida.—The construction company, of which R. W. Farris is the chief engineer, has submitted a proposition to the irrigation district to build the pumping plant project which would irrigate 10,000 acres. Estimated cost, $300,000 A. J. Wiley, engineer.

Spokane, Wash.—The Washington Land & Irrigation Co., owners of Fairview Heights, on White Bluff prairie, has made arrangements to irrigate this tract by means of wells. The officers of the company are: C. M. Crego, president; Maxon Chase, secretary, and A. M. Tate, treasurer.

Anacortes, Wash.—A local company has been organized here to dredge Fidalgo harbor. Among those interested are William Rodgers Lumber Co., Fidalgo Lumber Co., Anacortes Shingle Co., Baty Shingle Co., Burpee Bros. Co., Burke & McLean Shingle Co., Eureka Shingle Co., Cavanaugh Shingle Co., and P. E. Berard & Son.

Woodland, Cal.—The Sunset Telephone Company is making an effort to absorb the various farmers' lines that are now being operated in Yolo County, and has offered to connect all these lines with the Woodland exchange. The directors of the farmers' lines have decided to give the subscribers a voice in the matter before making an answer.

Los Angeles, Cal.—At a recent meeting of the city council the maximum rate which can be charged for unlimited service by both the Sunset and Home 'phone companies was fixed at $5.00. The rates for residence telephones are to remain as at present. Representatives of the telephone companies who were present were given no opportunity to protest.

Williams, Cal.—C. L. Schaad, president, and S. A. Lindstrom, electrical engineer, of the Colusa County Telephone Co., have been spending several days at Fonts Springs. Surveyors are busily engaged in locating lines for a system of flues, dams and pipe lines for a power system. The site of the power house has been located and one of the units which is to produce 3000 horsepower has been decided upon.

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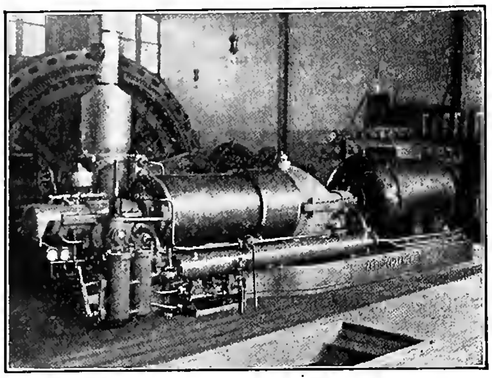
AS COMPARED WITH ALL OTHER LARGE TURBINE UNITS THUS FAR BUILT AND INSTALLED IN THIS COUNTRY IS LARGELY DUE TO THE THREE PRINCIPAL FEATURES OF CONSTRUCTION MENTIONED IN CONNECTION WITH THE ILLUSTRATION BELOW....

— FOR OTHERS SEE OUR BULLETIN NO. 1054 —



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FINANCIAL.

Lindsay, Cal.—An assessment has been levied by the Lindsay Water Development Company, due February 9th. Sale day is April 1st.

Hanford, Cal.—An assessment, delinquent February 1st, has been levied by the Washington Petroleum Company. The sale day has been set at April 13.

Bakersfield, Cal.—The annual meeting of the stockholders of the Superior Oil Company has been called for March 25. It will take place in Room 21, Bank of Bakersfield.

San Francisco, Cal.—President H. H. Noble of the Northern California Power Company, has submitted the annual report of the finances of the corporation. It shows that the net income has increased from $75,414.40 for the previous year to $96,243.37 for last year, a net gain of $20,828.97. During the year dividends amounting to $60,000 were paid, and $36,243.37 was reinvested in land, water rights and extensions.

Tonopah.—In order to facilitate the carrying out of the many improvements which are contemplated by the Nevada Power, Mining and Milling Company, the Nevada-California Power Company has been organized to take over all the property, water rights, and assets of the former company, and it has assumed all the liabilities as well. The new company is identical with the old one in ownership, control and management. It has a capitalization of $5,000,000, while the old company was capatilized at but $1,000,000. The new company by its charter is authorized to issue $3,000,000 in bonds, while the old corporations was limited to an issue of $1,000,000. The following extensions and improvements have been decided upon and contracts let. The extension of the company's power lines in the Bullfrog district and the installation of electric power and light systems in the entire Bullfrog district. The construction of an entirely new transmission line from Bishop Creek, Cal., to Silver Peak, Miller and Tonopah, to connect at the latter place with the present transmission line and giving duplicate service at all points now reached by the company's lines. The construction of two additional generating plants at Bishop Creek, which will more than double the generating capacity of the corporation. The construction of two reservoirs on Bishop Creek, the largest of which will have a capacity of 300,000,000 cubic feet, for the purpose of impounding the water supply so as to add to the low flow at certain times of the year. The construction of new transformer stations at Tonopah, Miller, Silver Peak, Goldfield and Rhyolite. It is estimated that the whole work of improvement will cost about $1,500,000.

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The Engineers' Architects' and Builders' News

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THE

Journal of Electricity, Power and Gas

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VOLUME XVIII. SAN FRANCISCO, CAL., APRIL 13, 1907 No. 15

The Economy of Electric Power in Quartz Mining.*

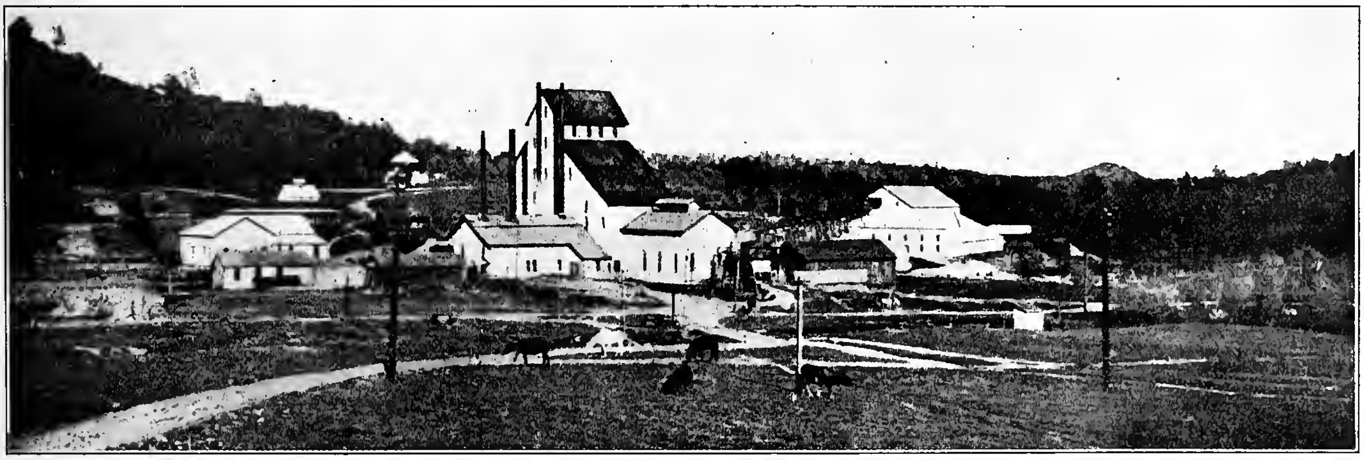
By C. O. POOLE

The subject matter of this paper has been largely obtained from the practice of the mines on the Mother Lode in Amador and Calaveras counties, California. This paper is not intended as a scientific treatise of the subject, but its object is to present in a practical way the economical results obtained by the use of electric power in comparison with steam power, using wood, coal and oil as fuel.

For more than fifty years the monotonous rumble of the stamp mills has echoed and re-echoed among the hills in the vicinity of Amador and Sutter Creek, and they seem destined to rumble for another fifty years, thus completing a century of echoes and prosperity throughout the community. Recent developments have demonstrated that almost inexhaustible bodies of ore lie far below the surface of the ground. Old mines that were thought to have been worked out, and were abandoned and left idle for a quarter of a century, have within the past few years been reopened, and their owners, by sinking deeper into the ground, were rewarded by striking large bodies of pay ore that insure a profitable return for many years to come.

The ore encountered in this locality is of low grade, ranging from $2.50 to $6.00 per ton; hence, in order to work a mine profitably under these conditions, it must be well managed. The mine superintendent must be a very versatile man; he must have good business judgment, and he must be scientific, mechanical, practical and economical. You must not be surprised, then, upon approaching him with a proposition to equip his mine with electric power, if your stereotyped arguments are received with a kind but pitying smile, and you in turn receive a very valuable lecture on power for mines. If, however, you are able to convince him that your proposition has merit, and a saving in cost of operation can be effected by its adoption, he will enter into the scheme with you, and better treatment than you will receive at his hands could not be asked for. Until quite recently the source of power at these mines has been steam and water power. The water wheels are working under heads varying from 160 feet to 520 feet. Water power under the last named head, at the prices now charged there, is about equivalent in cost to electric power at $6.50 per horsepower per month. On heads lower than this, however, it is obvious that material savings can be made, hence, water wheels in this locality are rapidly becoming a thing of the past.

The uses of water at a mine are somewhat varied, and in applying electric power, each case is a study by itself. The principal uses consist in driving stamps, concentrators, air compressors, sawmills, blowers, pumps and hoists. It is the hoist that I particularly wish to dwell upon. The conclusions that I draw in this connection may differ widely from the ideas of many, but I am, nevertheless, firm in my convictions.



A GENERAL VIEW OF THE ONEIDA MINE IN AMADOR COUNTY.

The fuel used for steaming purposes is principally wood and fuel oil. Coal has been used, but not to any great extent. The competitors to electric power are, therefore, wood and oil. If there is one mistake that a mine superintendent makes, it is in estimating the amount of power that he is using. He invariably over-estimates the actual horsepower consumed and owing to the intermittent character of the work (except that of the mill), it is very difficult to accurately estimate the power developed by a steam engine used in mining duty. If, then, you are told that he is making a horsepower for $8.00 or $10.00 per month with wood, don't be discouraged, for in obtaining these figures he may have divided his fuel bill by the rating of

*Reprinted by request from the July, 1902, number of the Journal of Electricity, Power and Gas.

a 100 horsepower engine, when the average power developed was less than fifty horsepower.

In order to demonstrate what can be done with steam power, let us enter into a few figures:

Wood.

A cord of dry pine wood (which is the variety of wood used in this section), weighs approximately 2,000 pounds, and its contents measure 128 cubic feet, of which about 56 per cent. is in wood and 44 per cent. is in spaces.

The composition of average air-dried wood, which carries 5000 British thermal units (B. T. U.) per pound, is as follows:

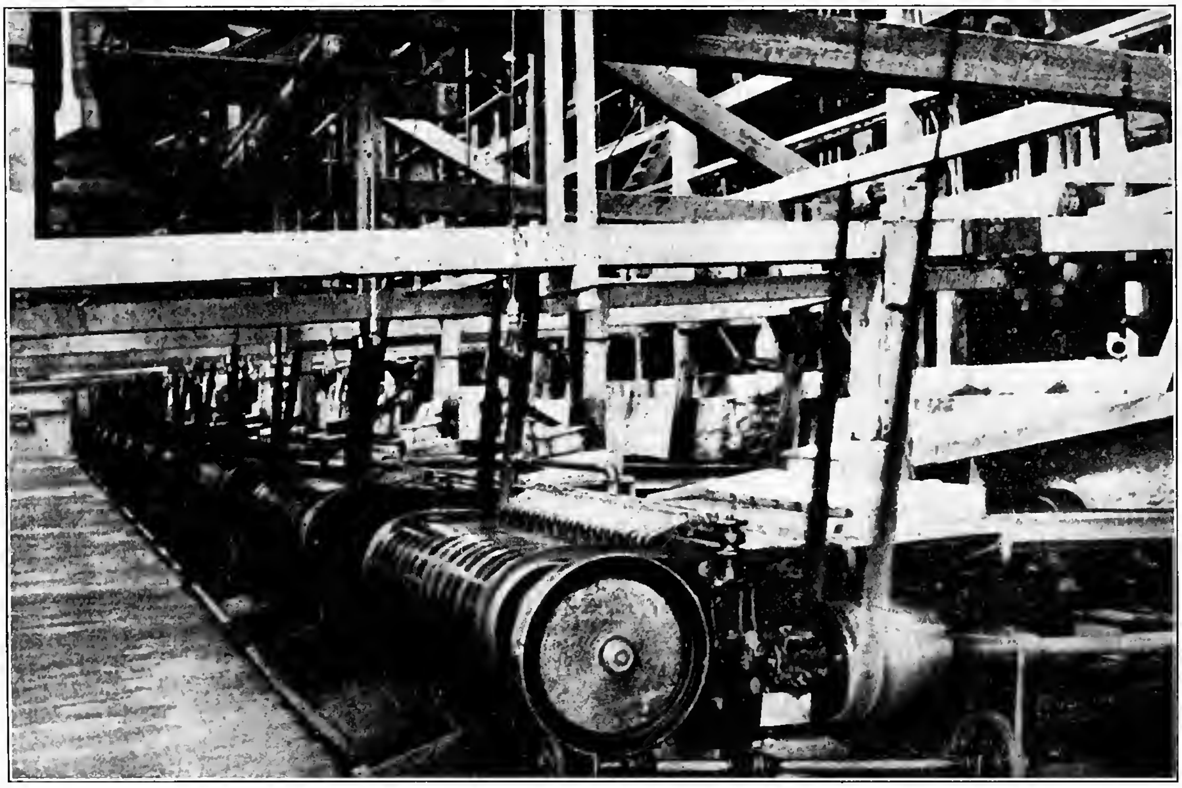
Carbon	37.50	per cent
Hydrogen	4.50	"
Oxygen	30.75	"
Nitrogen	.75	"
Ash	1.50	"
Hygrometric water	25.00	"
	100.00	per cent

Given the heat units in a pound of wood and the pounds of wood per cord, let us now proceed to demonstrate the cost of steam power with wood for fuel.

A pound of saturated steam at 90 pounds gauge pressure contains 1215 heat units. If the feed water, after passing through an exhaust heater, has a temperature of 150° F., then the actual heat units absorbed by each pound of water evaporated, will be 1215—150=1065 British thermal units. The theoretical evaporation of a pound of wood under these conditions will be $\frac{5000}{1065}$=4.69 pounds, which are the heat units contained in a pound of wood, divided by the heat units required to evaporate a pound of water.

Assuming a boiler efficiency of 65 per cent (which is as good as can be expected when working under variable loads), the actual evaporation under working conditions will be: 4.69x.65=3.048 pounds of steam per pound of wood; a cord of wood, then, weighing 2000 pounds, will evaporate 3.048x 2000=6096 pounds of water into steam at 90 pounds gauge pressure.

The ordinary simple non-condensing steam engine will consume 30 pounds of steam per horsepower hour, working on unsteady loads. If, then, we divide the total pounds of water evaporated by a cord of wood into the pounds of steam consumed per horsepower hour by the engine, we get $\frac{6096}{30}$=203 horsepower hours. Taking the cost of wood at $5.00 per cord, the cost per horsepower hour will be $\frac{\$5.00}{2.03}$ =$0.0247. As there are 720 hours in a thirty day month, the cost per horsepower per month will be $0.0247x720= $17.78. While it is possible to do somewhat better than this with a plant working under favorable conditions, it will be found in general mining practice that the price is rather above this figure than below it.



THE ONEIDA CONCENTRATORS ARE DRIVEN BY A 30 HORSEPOWER INDUCTION MOTOR

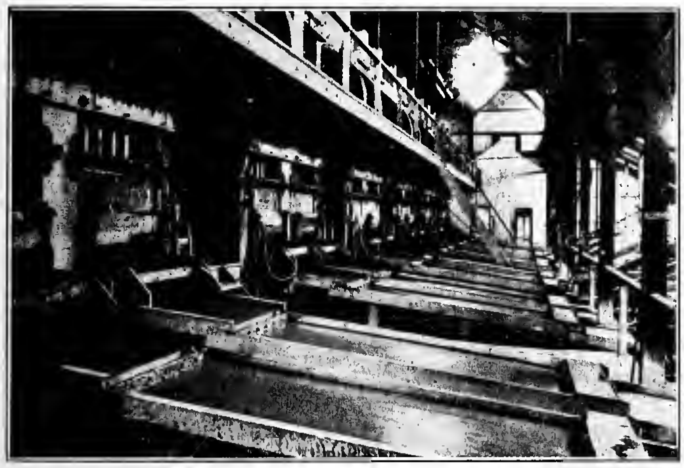
Through the kindness of Mr. J. C. Kemp Van Ee, of the Royal Consolidated Mine, Calaveras County, I am able to present the results of an efficiency test of a steam plant working under almost ideal conditions. The plant in question is driving a 40-stamp mill, consisting of 20 stamps weighing 1050 pounds each, and 20 stamps weighing 800 pounds each, all with a drop of 5½ inches, making 110 drops per minute. The mill contains 12 concentrators in addition to the mill equipment, and the engine drives a 7-kilowatt generator for supplying lights for the mill and houses. The results of this test follow:

EVAPORATION TEST OF SECOND GROWTH PINE WOOD.

Type of boiler	Horizontal tubular.
Size of boiler	66 inches diameter by 16 ft. long
Number of tubes	98 three-inch tubes.
Heating surface of shell	=132 square feet.
Heating surface of tubes	=1230 square feet.
Total heating surface	=1362 square feet.
Grate surface	25 square feet.
Ratio of heating surface to grate surface	=54.5 to 1.
Duration of test	10 hours.
Amount of wood burned	=2⅝ cords.
Weight of wood burned	=9331 pounds.
Weight of wood per cord	=3554 pounds.
Total water evaporated	=25,124 pounds.

Temperature of feed water.... 60 8° F.
Steam pressure, average gange. 101 4 pounds.
Water evaporated per pound of
wood, actual conditions.... =2.693 pounds.
Water evaporated per pound of
wood from and at 212°.... =3.224 pounds.
Quality of steam............ Practically dry.

While the test shows an evaporation of 3.224 pounds of water per pound of wood, the results actually obtained in practice are about 12 per cent better than this, as the feed water is heated by the exhaust steam from the engine and enters the boiler at 198° F. Owing to the difficulty of arranging the weighing device for handling the feed water after passing through the heater, we were forced to use cold water, cutting the heater out of service. Adding this 12 per cent, the evaporation is 3.61 pounds of water per pound of wood.



THE 60-STAMP MILL AT ONEIDA MINE IS DRIVEN BY A 150 HORSEPOWER INDUCTION MOTOR

The heat units imparted to the water were 1117x25,124= 28,063,508. Assuming an efficiency of 70 per cent for the boiler, the total heat units given out by the wood was $\frac{28,063,508}{70}$=40,090,725, and the heat units per pound of wood amount to $\frac{40,090,725}{9331}$=4296, which is about right for that class of wood.

The power cost for running this mill with wood at $4.25 per cord, is as follows:

Fuel cost per horsepower hour......	$0.0103
Labor cost per horsepower hour....	0.0023
	$0.0126

Making the cost per horsepower per month to amount to $9.07.

The results obtained from this plant are surprisingly good, but it must be borne in mind that it is a very efficient plant, which is working under the most favorable conditions. The boiler and engine are properly proportioned for the duty, the load is constant, the engine cuts off at the proper point to obtain the best results from the expansion of the steam, and the feed water is heated to a remarkable degree. I think it will be acknowledged that a plant operating under the fluctuating conditions of the average mining load, such as hoists, air compressors, pumps, rock crushers, sawmills, etc., that the consumption of steam per horsepower hour will reach from 30 to 35 pounds instead of 23, as shown by the test data above, and the efficiency of the boiler will be below 70 per cent.

Coal.

A good quality of steam coal yields 13,000 British thermal units by oxygen calorimeter, the approximate analysis being as follows:

Moisture	3.50 per cent.
Volatile combustible matter..	34.27 " "
Fixed carbon	54.23 " "
Ash and waste	8.00 " "
	100.00 per cent.

This quality of coal can be landed at the mines for about $13.00 per ton of 2240 pounds. Under the same conditions upon which wood was figured, the cost of power, using coal for fuel, will be approximately as follows:

Theoretical evaporation=12.2 pounds of water per pound of coal.

Actual evaporation under working conditions=7.93 pounds of water per pound of coal, which=17,763 pounds of steam per ton of coal.

Horsepower hours per ton of coal=592; cost per horsepower hour=$0.022; cost per horsepower per month=$15.84.

While this cost appears somewhat less than wood, yet for general mining work wood has many advantages over coal.

Fuel Oil.

We now come to the real competitor of electric power in California,—wood and coal having fallen an easy prey—but oil offers a more stubborn resistance, especially in the valleys or at tide water, where it can be landed to the customer at a price of 67 cents a barrel. In the mining districts, however, where the transportation rates are high and oil costs $1.50 per barrel, it is not such a formidable foe. It is well, however, for the transmission people to keep informed on the oil situation, for oil has come to stay in California.

Within the past few years, the oil developments in this state have been phenomenal, and the hundreds of thousands of acres of oil lands which are already prospected and developed, insure a supply for many years to come. The oil sands in the Kern River and Bakersfield districts range in thickness from a few feet to five hundred feet, and they contain from 30 per cent to 40 per cent of oil. Of course, all of this cannot be extracted by the ordinary methods of pumping, but it is safe to say that 10 per cent of the bulk of good oil sand is extractable.

Here are some characteristics of various crude oils:

ANALYSIS OF BEAUMONT CRUDE.

Gravity	= 21° B.
Flash point	= 142° C.
Burning point..................	= 181° C.
Cold test	= —6° C.
Carbon	= 85.03 per cent.
Hydrogen	= 12.30 " "
Oxygen and Nitrogen...	= .92 " "
Sulphur	= 1.75 " "
	100.00 per cent.

British thermal units by oxygen calorimeter=19,060.
5 per cent of steam required to vaporize in burners.

ANALYSIS OF VENTURA COUNTY CRUDE.

Gravity	= 23.5°B.
Carbon	= 84.0 per cent.
Hydrogen	= 12.7 " "
Nitrogen	= 1.7 " "
Oxygen	= 1.2 " "
Sulphur	= 0.4 " "
	100.00 per cent.

GRAVITY OF DIFFERENT CALIFORNIA OILS.

Central oil fields, Los Angeles.....16° and	17° B.
Mackintosh wells, Los Angeles....	13° B.
Maltman Tract....................	14° B.
Summerland, Santa Barbara Co.....15° to	17° B.
Sunset Oil District, Kern Co.......	15° B.
Tar Creek	23° B.
Four Forks	22° B.
Kentuck	25° B.
Coalinga (Oil City)..............	34° B.
Puente Oil Wells.................23° to	28° B.
Pacific Coast Oil Co., Pico Canyon	40° B.
Tuntas Creek, San Mateo Co......	45° B.
Moody Gulch, Santa Clara Co.....	44° B.

GRAVITIES OF CRUDE OIL. BEAUME HYDROMETER, TEMPERATURE, 60° F.

	Specific Gravity.	Weight per Bbl.	Barrels per Ton.		Special Gravity	Weight per Bbl.	Barrels per Ton
15	.9655	338	6.63	28	.8860	310	7.24
16	.9589	338	6.69	29	.8805	308	7.28
17	.9523	334	6.73	30	.8750	306	7.32
18	.9459	331	6.77	31	.8695	304	7.37
19	.9395	328	6.82	32	.8641	302	7.42
20	.9333	326	6.87	33	.8588	300	7.47
21	.9271	324	6.91	34	.8536	299	7.52
22	.9210	322	6.96	35	.8484	297	7.56
23	.9150	320	7.01	36	.8433	296	7.60
24	.9090	318	7.06	37	.8383	294	7.65
25	.9032	316	7.10	38	.8333	292	7.70
26	.8974	314	7.15	39	.8284	290	7.75
27	.8917	312	7.19	40	.8235	288	7.79

It will be seen from the table that the weight per barrel varies perceptibly with the gravity, and at first sight it may appear that the low gravity oil would be cheaper to use, but in fact there is very little difference in the fuel value of a barrel of oil, whether the gravity be 14° or 34°; for while there are more pounds in a barrel of low gravity oil, there are less heat units per pound.

From an average of several samples that I have tested, 16° B. oil contains 18,000 British thermal units per pound, and 34° B. oil contains 22,200 British thermal units.

Coming back to the original subject, let us work out the cost of steam power with oil for fuel, under the same conditions that wood and coal were treated.

A barrel of 16° B. oil weights (allowing for wastage) 330 pounds, delivered; heat units per pound=18,000, theoretical evaporation=16.9 pounds; actual evaporation—boiler efficiency at 65°=10.98 pounds; pounds of water evaporated per barrel of oil=3623; horsepower hours per barrel of oil=120.7; price per horsepower hour, oil at $1.50 per barrel=$0.0142; price per horsepower per month=$8.93.

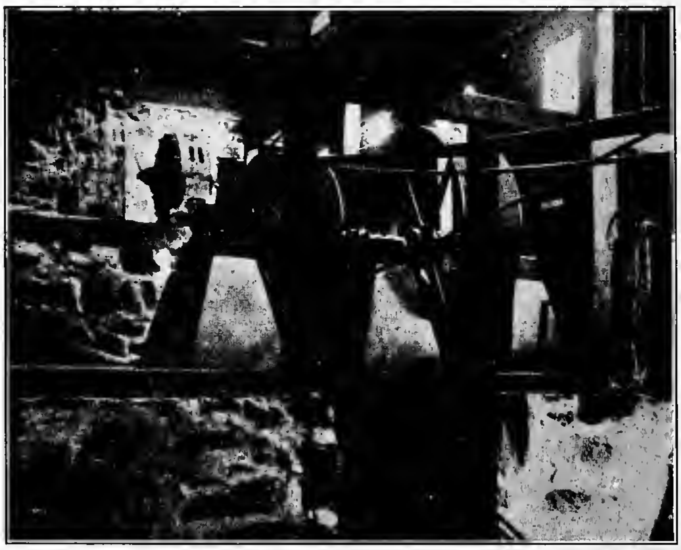
This result can be obtained under the most favorable conditions, but it is safe to say that with ordinary mining practice, it will cost at least 30 per cent more than this amount, for oil on a variable load is more difficult to handle economically than either wood or coal, and the losses are consequently far greater. The true cost per horsepower month, would then be fully $11.90.

Taking the cost of electric power at $6.50 per horsepower month, the comparative costs for power will be as follows:

Wood......	$17.78	Saving effected by electric power..	$11.28
Coal.......	15.84	" " " " " ..	9.34
Fuel oil...	11.90	" " " " " ..	5.40

The mine superintendent takes kindly to the electric motor for all purposes except for hoisting, and to my mind his exception is well taken, for until a simple, better and more reliable electrical hoist is developed I will hesitate to recommend them to a customer. In my opinion, compressed air is going to be universally used for hoisting purposes, where cheap electric power is obtainable and when a compressor is required for other purposes in the mine. In the ordinary use of a compressor at a mine, it is not used to its rated capacity more than 40 per cent of the time. If, then, receiver capacity be available to store the air at times of light demand upon the compressor by the drills, and thus enable the compressor to be operated at full load all the time, the motor and compressor would be run at their highest efficiency and sufficient air could be stored to operate the hoist under ordinary conditions, and quite efficiently, too, by re-heating the air. It is not generally known that a pound of coal used for re-heating air will produce a horsepower hour, while it requires from four to five pounds of coal to give the same result with steam; but such is the case, if the air be used in an engine fitted for the purpose.

But, for the sake of argument, let us suppose that we use the air without re-heating, and assume that air and steam are equal, so far as expansive effects are concerned; then, if electric power costs $6.50 per horsepower per month, and the compressor has an efficiency of sixty per cent., the cost for air delivered to the engine will be $10.83, as against oil at $11.90, and by using a small amount of fuel for re-heating, these results can be far exceeded.



AT THE KEYSTONE MINE A 300 HORSEPOWER INDUCTION MOTOR RUNS A COMPRESSOR THROUGH A ROPE DRIVE

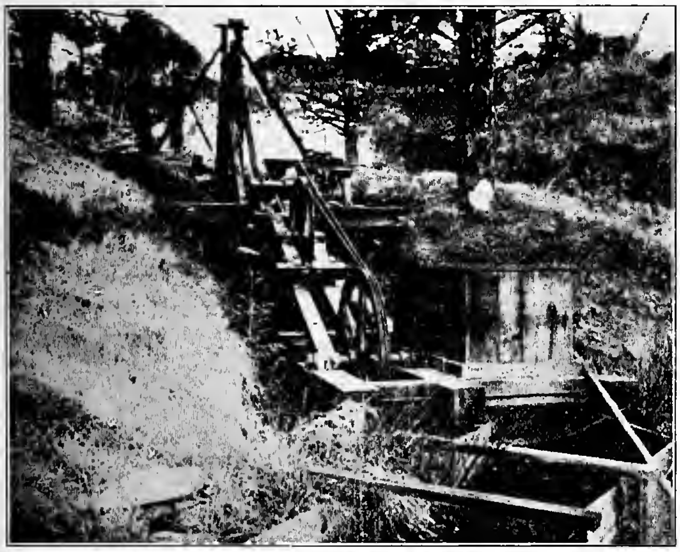
At the Lightner Mine, Calaveras County, electric power has been used exclusively for several years. A 150-horsepower motor drives a two-stage compressor thirteen inches by twenty-two inches stroke, and running at seventy-five revolutions per minute. The sawmill, a pump and a blower are also driven by the same motor. The relief pipe from the air receivers is connected to the steam boilers, two of which act as additional receivers, and another one of them being used as a re-heater. About one cord of wood is burned per day in re-heating. There is operated a sixty-stamp mill, which is driven by a 100-horsepower induction motor; a twenty-horsepower motor drives the rock crusher, and a five-horsepower motor is used for operating a telpherage system for carrying sulphurets to the chlorination works. All the hoisting is done with compressed air, as is also the lifting of all the water, which is taken from the 600-foot level. In addition to this work, seven 3¼-inch drills are supplied with air from the same compressor. The total power bill for January, 1902, was $1,457.50, including the cost of the wood used for re-heating purposes, which makes the power cost per ton of ore milled to be twenty-one cents, including all power charges.

Through the kindness of Mr. J. B. Tregloan, of the South Spring Hill Mine, near Amador City, I am permitted to present some data on results obtained at his plant, and which were published in "The Mining and Scientific Press," for April 20th, 1902. This publication gives the results actually obtained at this mine, as follows:

The South Spring Mine is using a 10x18-inch duplex,

single-stage, belt-driven compressor, the area of the outlet ports being nine inches square on each end of each cylinder, the port area being reduced to six and one-quarter square inches, where it enters the main pipe, which is a disadvantage, but which in this particular compressor, is unavoidable. The water jacket covers only three-fourths of the surface of the cylinder, one-quarter being taken up by air ports, which is another defect in construction. The working pressure varies from seventy-five to eighty-five pounds, blowing off at eighty-five pounds. The compressor runs fifty-nine revolutions per minute, the valves being of the ordinary poppet type.

In driving this machine, a 30-horsepower General Electric "Form K" compressor type induction motor is used; speed, 900 revolutions per minute; voltage, 550; the current being transformed from 10,000 volts in a separate building, about 250 feet from the compressor house, and measured on the low tension side by an integrating Schallenberger wattmeter, 746 watts being considered the equivalent of a mechanical horsepower. The current is transmitted from the Standard Electric Company's plant, near Jackson, Amador County, California, a distance of eight miles. The price per horsepower by meter measurement is $6.50 per month, which is the maximum rate, and which is reduced somewhat according to the amount of horsepower contracted for above a certain amount. The compressor pumps directly to a small receiver, in this case too small by 500 cubic feet, the total storage



A RELIC OF THE PAST—A WATER WHEEL ROPE DRIVE

being only about 100 cubic feet, allowing altogether too sudden fluctuations in air pressure, and not enough to carry all the air compressed during the small periods of idleness of power drills and hoisting engine, without blowing off air.

This brings up the important point in compressor practice, that blowing off air is a large item of expense, is wasteful and is an apparent negligence of proper installation, but for some unaccountable reason it is generally considered unavoidable in a compressor plant. Provide plenty of storage capacity, and install the right size of compressor, and compressed air will be an economical and not an expensive commodity, as is the opinion of most of its users.

In the case of the South Spring Hill Mine, the blow-off of the receiver is so arranged that it empties into the steam boiler, where it is re-heated and used in the hoisting engine, passing in just above the water line through the front end of the boiler, as shown in the illustration herewith. When the power drills are not operating, the lever is raised and all the air passes to the boiler for hoisting purposes. Attention is called to the accompanying sketch already referred to and showing the general arrangement of the plant. Where it is possible to do so, elbows are avoided and long sweeps, made by bending the pipe, are used; these bends being made very carefully to avoid any crushing of the side of the pipe.

Where pressure in the receiver rises above seventy-five pounds per square inch, it overcomes the weight and escapes through the three-inch check valve, whence it passes out through the side opening of two and one-half inch tee (through which passes the stem shown in dotted lines), and thence to the steam boiler. A check valve shown in the illustration prevents the steam from backing out of the boiler when the air is below steam pressure; this arrangement makes the blow-off on the steam boiler to be the blow-off of the compressor. Air is used cold in the power drills, but in the engine it is re-heated to about the temperature of steam at forty pounds pressure.

The average consumption of fuel used in combination with electricity in this plant for sixty days was—

Twenty horsepower per day at a cost of.....	$ 270.00
Wood burned in meantime, 37½ cords at $6...	225.00
Total cost of power........................	$ 495.00
Under former conditions it required—	
Two cords of pine wood per day, 120 cords at $6	$ 720.00
Water power for compressor (very favorable conditions), two months	350.00
Total by wood and water..............	$1070.00
Tons of rock broken by power drills, and hoisted 550 feet	2667
Tons of water hoisted 600 feet..................	3600

Under the present conditions, should the power drills and hoisting engine be idle, all at once, for more than one minute, the air blows off because of the lack of storage, which, as soon as rectified, should make a difference of at least ten cords of wood. Electricity at $6.50 per horsepower month is at the rate of about twenty-one cents per horsepower for twenty-four hours. Consuming, as this plant does, about twenty horsepower per day, means $4.50 per day to produce enough air at eighty pounds pressure to operate two power drills (3¼-inch cylinders), and leave a surplus for the hoisting engine sufficient to save the use of over one and one-quarter cords of wood per day. Hal all the air pumped to eighty pounds been conserved by ample storage, the use of less than one-half cord of wood would have been sufficient for all re-heating purposes, and supply steam at times when air pressure was low.

The results obtained by the use of compressed air for hoisting purposes in the above instances, should convince the most skeptical mind that it is economy to use compressed air for hoisting with electric power at $6.50 per horsepower per month, against the prevailing prices of fuel. At the present time there are several large compressed air plants in course of erection in Amador County, all of which are to be electrically driven, and re-heated air is to be used for hoisting.

With an installation of this kind properly proportioned as regards motor, compressor and receiver capacities, to my mind, it leaves little to be desired, from the point of economy, convenience and reliability.

The old Keystone Mill consisted of forty 725-pound stamps, ninety-six drops, 7.5-inch fall, and sixteen concentrators.

The total power required was eighty-five horsepower, or 2.12 horsepower per stamp. When this mill was operated by steam, using pine wood for fuel, seven cords per day were consumed; this, at $5.00 per cord, equals $35.00 per day, or $1,050.00 per month; add to this the wages of two firemen, equals $1,200.00 per month. The cost of electric power at $6.50 per horsepower per month equals 85x$6.50 equals $552.50, showing a saving of $647.50 per month.

This mill has recently been increased to sixty stamps and

twenty-four concentrators. The new stamps are 1,000-pound, making 100 drops, 5.5-inch fall.

Measurements made on the Central Eureka Mill showed a consumption of forty-six horsepower for twenty 850-pound stamps, ninety drops, 6.5-inch fall, including eight concentrators. This is at an average of 2.3 horsepower per stamp. The mill was driven by a fifty-horsepower induction motor. Since this data was obtained the owners have increased the capacity of the mill to forty stamps, and have installed a 100-horsepower motor to drive it. Preparations are now being made to install an air compressor to be driven by the fifty-horsepower motor taken from their mill, and when this is done compressed air will be used for drilling and hoisting. The total electrical installation will then be:

Mill	100	horsepower
Compressor	50	"
Rock crusher	12.5	"
Blower	7.5	"
	170	horsepower

The Oneida Mill is running sixty 1,100-pound stamps, ninety-four drops, 7.5-inch fall. The power required to run the mill, including thirty concentrators, is 175 horsepower, or 2.91 horsepower per stamp. The stamps are driven by a 150-horsepower induction motor, and the concentrators are driven by a thirty-horsepower motor. The motors, batteries and concentrators are shown in figures 3 and 4.

This mine is also using a 50-horsepower motor on its rock crusher, a 75-horsepower motor in its sawmill and a 125-horsepower synchronous motor driving its air compressor. It is preparing to install a 125-horsepower motor in the mine for driving a pump, which will make a total installation of 555 horsepower. The total power cost per ton of ore milled at this mine is about thirty cents. The cost of power for the mill when all stamps are run continuously is $1,137.50 per month. This mine is hoisting and pumping by steam, with oil for fuel.

I might mention that a 100-horsepower motor has recently been installed in this mine for driving a pump, and is doing excellent work. I understand this pump is to be the subject of a paper to be presented at this meeting. My belief is that electrically-driven pumps will soon be a common thing on the Mother Lode, and from the point of efficiency and convenience, it certainly leads any of the methods now employed.

It is well understood that the ordinary steam pump is a very extravagant piece of apparatus, owing to the fact that it takes steam full stroke, and makes no pretense of cutting off in order to use the steam expansively; this is especially true when compressed air is used instead of steam, for it must be distinctly understood that economical results cannot be obtained with compressed air, unless the benefits to be derived from expansion are taken advantage of. In order, then, to realize the best results from compressed air for pumping purposes, an engine-type pump should be used with an adjustable cut-off, thus enabling the valves to be set for the duty the pump is to perform.

While compressed air affords a very convenient method of pumping, the difference in efficiency between that method and electrically-driven pumps, permits of no argument, electricity having fully thirty per cent. the advantage.

MOVING-PICTURE EXHIBITS AND THE DEPARTMENT OF ELECTRICITY, WATER AND GAS IN NEW YORK CITY.

The Department of Electricity, Water and Gas, New York City, in conjunction with the Fire Department and the National Board of Fire Underwriters, has been conducting a crusade against the manipulators of moving-picture machines in New York City. About a year ago the electrical bureau of the Department of Electricity, Water and Gas began a careful inspection of these devices and discovered great indifference to rendering this apparatus even a reasonably safe fire hazard. New York City, in fact, is the pioneer in the movement toward making these machines safe. In most instances, when this crusade was begun, the celluloid films were placed upon an open reel at the top of the machine and allowed to fall into a flannel bag at the bottom of the machine, without any protective devices or shields surrounding this highly inflammable material. Under the direction of the experts of the electrical bureau the machines are now being equipped with sheet metal cases encasing the reels both above and below the projecting apparatus. Where the celluloid film leaves the upper case, and again where it enters the lower case, it passes between brass rollers, which would smother any flame which might be started outside of the cases. This would effectually prevent the greater portion of the film taking fire and creating an extensive conflagration.

It has been demonstrated that the operator sometimes held the film in the beam of light from the arc lamp, while making an adjustment at the arc, so long that the film took fire. In order to obviate this possibility the machines are now fitted with an automatic screen, so arranged that the beam of light cannot fall upon the film until the machine has come up to speed. In this way, if the operator stops the movement of the film, the filter is interposed between the arc light beam and the celluloid.

The department has also prescribed certain regulations affecting the use of resistances, flexible connections and arrangement of auxiliaries.

The Department of Electricity, Water and Gas, in order to make violations of its recommendations as few as possible, is now issuing permits good for thirty days. The number indicated on these certificates must correspond to the number of the name plate on each machine. This obv'ates, in a measure, the possibility of the operator securing a number of certificates upon one good machine by moving it from place to place, and operating a corresponding number of bad machines in different sections of the city.

30,000 VISITORS EXPECTED AT LOS ANGELES DURING THE N. E. A. CONVENTION.

Los Angeles expects over 30,000 visitors to the National Educational Association convention, which is to be held in that city July 8th to 13th of this year. Elaborate preparations are being made for the entertainment of the excursionists, not only by Los Angeles, but by nearly every community in the State. The trains will be met at the State line by members of the Reception Committee, who will greet the visitors with California fruits and flowers. From the arrival of the first contingent of excursionists, California will keep open house. The railroads have made exceedingly low rates. From Chicago and intermediate points the rate will be one fare plus $2.00 for the round trip. In the State the rate for California side trips will be one and one-third fares for the round trip from Los Angeles and San Francisco to interior points of the State. Stop-overs will be granted at any point en route. These tickets will be sold to the excursionists and any friends accompanying them. California has become the all-the-year-round playground of America. The beach and summer resorts, with their unexcelled hotels, will offer an inducement to the excursionists to make this trip their summer outing, as the tickets are good for final return until September 15th. Los Angeles is the center of an electric railway system of nearly 700 miles of inter-urban and 175 miles in the city, which gives cheap and easy transportation to the resorts of Southern California.

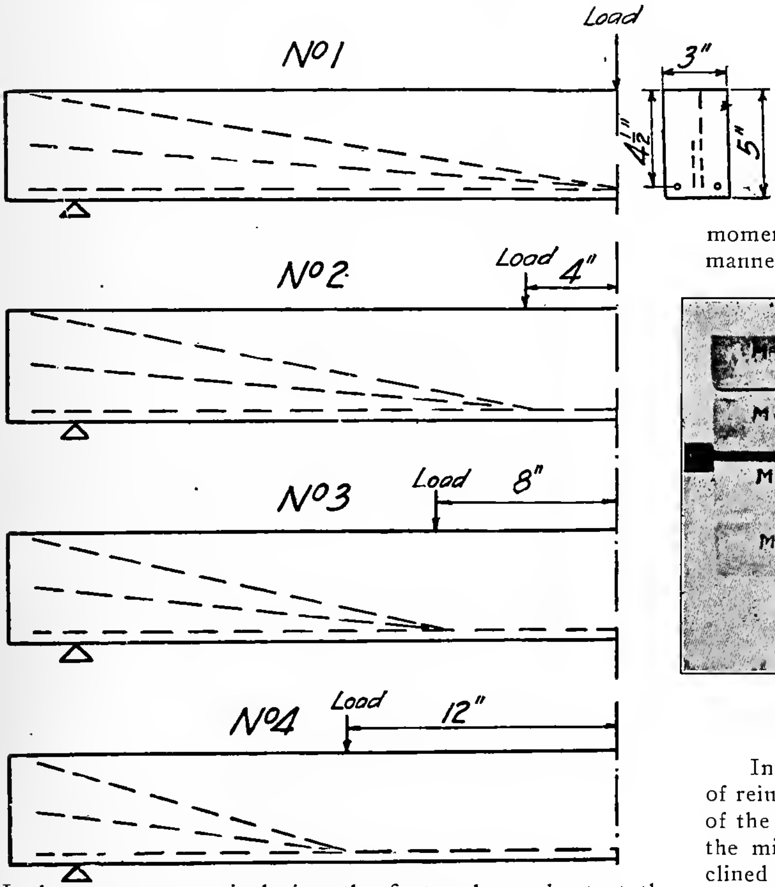
At the convention the principal addresses will be made by some of the most distinguished scholars of Europe and America. The University of California at Berkeley will hold a Summer School, at which it is expected a large number of the visitors will be in attendance on account of the opportunity to combine the pleasure of a California outing, attendance at the National Educational Association convention and Summer School work.

VARIOUS METHODS OF REINFORCING.*

The proper method of reinforcing a beam against various internal stresses is a very important one, and as yet has not been satisfactorily determined. When reinforced concrete first came into general use it was thought that horizontal reinforcement was sufficient, and the peculiar failures which often occurred were usually ascribed to pulling out the rods, an idea which led to the invention of the various forms of deformed bars now on the market. It has been found, however, that even beams reinforced with deformed bars often fail along inclined cracks, and that something besides horizontal rods is necessary to prevent such failures. Stirrups have been used extensively with this end in view; although they assist in carrying the internal stresses to some extent, their use in the usual manner will not always prevent inclined tension failures.

Messrs. Gilman and Kahn used stirrups in a number of their beams, and, although these beams were found to be somewhat stronger than those without stirrups, they still failed to develop the full compressive strength of the concrete or the tensile strength of the steel.

Another method used in their tests, and also in the succeeding ones, was to bend the horizontal rods at an angle of forty-five degrees at equal intervals between the loading points and the support. The results of all these tests are given in Table M-3. The beams were all 5-inches by 3-inches in section with a span length of 48 inches, made of a 1:2½ mortar, and reinforced with four ¼-inch round rods. The positions of the loads are given in the table. The rods were bent up at the quarter points between loads and supports.



In beams 13 to 24, inclusive, the first rod was bent at the point of loading, the second rod was bent at one-quarter of the distance from this point to the support, and so on; thus no rod was horizontal all the way through. In beams 1 to 12, inclusive, the first rod was bent at the point where the second one was bent in the previous beam, so that in each beam one rod was straight over its full length. In both cases all of the four rods were horizontal between loads. The four rods were tied in a bundle so as to make the section as nearly symmetrical as possible with respect to a longitudinal plane through the center of the beam.

With the exception of three of the beams with loads at or near the center all these beams failed by inclined tension, this being the favorite method of failure of all beams reinforced with only horizontal rods. The failures occurred on lines through the bent rods, the rods slipping sooner or later as the bent portions were not long enough to offer sufficient adhesion to carry the inclined stresses. Strictly vertical shear failures were obtained in several of the beams of this set which had the loads applied very close to the support. The inclined tension failures are here called shear failures and the same term is also used in all the other tables, so that, except for the several beams in Table M-3 which failed by vertical shear, wherever a failure is called a shear failure, inclined tension is meant.

Another method of bending the rods was tried with better results. This series consisted of four beams reinforced as shown in the diagram, Figure M-3, with two rods running straight through and two bent at the loading points. The inclined cracks as they usually occur in a concrete beam are approximately perpendicular to the direction of these rods; therefore, these rods should be very efficient in preventing this failure. This was actually found to be the case. Series G, the results of which are given in Table M-3, was designed for the special purpose of determining this in a preliminary way, and all the large beams made later were provided with this system of reinforcement.

Three of the beams of Series G failed in tension at the center, while similar beams with the same loading and provided with only straight rods or rods bent at an angle of forty-five degrees failed by inclined tension. In the last beam, G-4, the loads were too near the supports to give a moment failure. A photograph of these beams showing the manner of failure is given in Plate M-II.

PLATE M—II.
Beams of Series G after testing.

In the tests of the 8-inch by 11-inch beams this method of reinforcement gave equally as good results. All the beams of the 1:2:5 concrete, except No. 13, failed by tension within the middle third of the beam. In every case the usual inclined cracks near the ends appeared, but were prevented from developing by the bent rods. Two per cent. reinforcement was stressed to its elastic limit in these beams. In the case of No. 13 failure near the end occurred after the cracks near the center had opened up considerably and the steel had apparently been stressed to its elastic limit. In fact, this beam carried a greater ultimate load than its duplicate, No. 15, which failed by tension near the center. It is desirable to emphasize the fact that this failure was not caused by a

*"Tests on Reinforced Concrete Beams," by Ernest Anthony Moritz. Bulletin No. 148, issued by the University of Wisconsin.

pulling out of either the inclined or straight rods. The final failure occurred by a prying up of the upper half of the beam at the end, which seems to indicate that stirrups would be very efficient at this point in connection with the inclined rods.

Three of the 1:3:6.5 beams failed by inclined tension. These failures were perhaps due to slipping of the inclined rods. By comparing these three beams, Nos. 10, 12 and 16, with the others of this set it is seen that similar beams failed by compression at the center with practically the same or smaller loads, and that, therefore, these three beams had probably reached their full compressive strength when failure near the end occurred.

Anchored Rods.—It has been claimed that beams with straight rods anchored at the ends are stronger than without

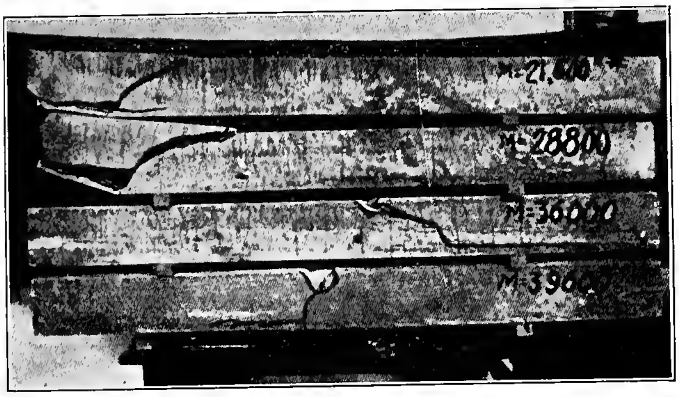


PLATE M-IV
Beams with anchored rods after testing

the anchorage, and that the horizontal cracks often observed in the plane of the reinforcement are due to pulling out of the rods. With a view to investigating this, four beams were made with horizontal rods anchored at the ends. The anchorage consisted of a rectangular bar of steel with holes bored through to allow it to be slipped over the ends of the reinforcing rods. The rods were then bent back over this bar so that they had a firm bearing. The loads were applied at 12, 16, 20 and 24 inches from the supports. Plate M-IV is a photograph of the broken beams. From the picture it is seen that all four beams failed in the manner typical of beams with only horizontal reinforcement.

Plate M-V shows the condition of the ends of two of

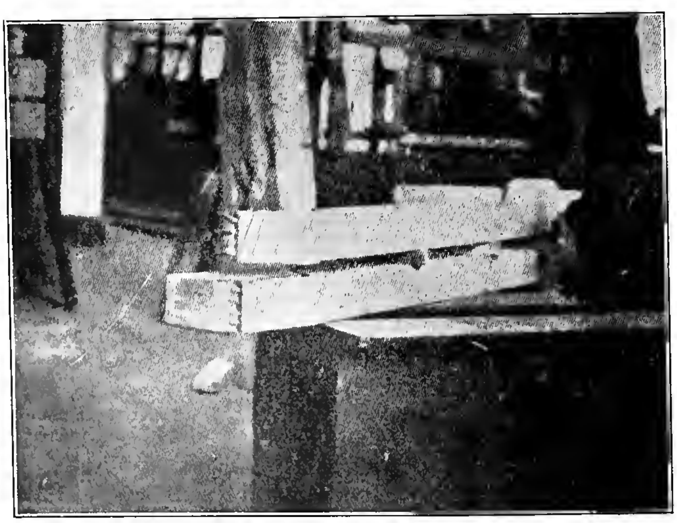


PLATE M—V
View of anchorage after test

perfectly solid, the rods did not slip at the ends; therefore this crack cannot be due to pulling out of the rods. A comparison of the strengths of these beams with those of Series B is given in Table M-2. Since the two sets of beams were exactly alike except for the anchorage, the results are directly comparable.

It would be rash to draw final conclusions from these few tests, but they seem to show, first, that the horizontal the beams, from which it is seen that as the anchorage was crack in the plane of the reinforcement is not due to pulling out of the rods, but that it is due to the pulling of the concrete upwards away from the rods, and therefore cannot be prevented by anchoring the rods at the ends; and, second, that anchoring the rods does not make the beams stronger with the proportions here used.

Table M—2.

Comparison of Strength of Anchored and Unanchored Rod Beams.

No. of beam.	Max. Load.	
	Anchored.	Not anchored.
1	3300	3500
2	3600	3700
3	3600	4300
4	3600	4900

Table M—3.

Strength of Beams With Varying Points of Loading.

5-in.x3 in. x 48-in. span; net depth, 4½ in. 1.44 per cent. steel, 60,000 lbs. elastic limit; 1:2½ mortar.

Note—Beams marked "A" had rods bent up at an angle of 45 degrees at quarter points between loads and supports. Beams marked "G" are shown in Fig. M-3.

No. of beam.	Max, moment. Inch-pounds.	Max. shear pounds per Sq. in.	Kind of failure.	Distance of loads from supports. Inches.
A 1	39,400	110	Moment	Center
A 2	47,100	140	Shear	22
A 3	43,400	145	Moment	20
A 4	39,600	145	Shear	18
A 5	39,200	165	Shear	16
A 6	36,700	175	Shear	14
A 7	41,600	230	Shear	12
A 8	48,000	320	Shear	10
*A 9	32,800	270	Shear	8
*A10	24,600	270	Shear	6
*A11	26,600	440	Shear	4
*A12	11,100	370	Shear	2
A13	39,600	110	Shear	Center
A14	34,800	95	Moment	Center
A15	34,000	115	Shear	20
A16	36,000	120	Shear	20
A17	35,200	145	Shear	16
A18	30,800	130	Shear	16
A19	30,300	170	Shear	12
A20	27,300	150	Shear	12
A21	24,000	200	Shear	8
A22	24,300	200	Shear	8
A23	22,000	370	Shear	4
A24	19,600	330	Shear	4
*G 1	34,800	100	Moment	Center
*G 2	36,000	120	Moment	20
*G 3	36,800	155	Moment	16
*G 4	29,400	165	Shear	12

*50,000 lbs. elastic limit steel.

ELECTRICAL UNDERTAKINGS IN JAPAN.

The Japanese Empire is a good field for manufacturers of electrical devices. According to the list of Japanese enterprises formally organized and projected since July, 1905, furnished by Consul-General H. B. Miller, of Yokohama, the new capital of companies building electric railways amounts to $55,825,000, and the investment in other electrical enterprises is $49,711,500, of which $27,375,000 is employed in developing Japanese water-powers. Only $14,825,000 has gone into steam railways. In all $248,896,500 fresh capital has been contributed to Japan's industrial expansion since the Treaty of Portsmouth.

SOME IMPORTANT DATA REGARDING THE ELECTRIC FURNACE.

In connection with some very valuable experiments recently performed in the investigation of the compounds formed by the borides and the silicides through the use of high temperatures, some data concerning the electric furnace have been obtained which will be of general interest.

These tests were made by Mr. Oliver Patterson Watts, Ph. D., as subject matter for a thesis presented to the University of Washington for the degree of Doctor of Philosophy, and have been published by the university in bulletin form.

The electrical equipment used as the source and control of the current is described as follows:

The dynamo which supplied current for most of the experiments was a direct-current 110-volt machine, rated at 825 amperes. Alternating current with variable voltage was also available up to twenty kilowatts, and was occasionally used.

The direct current most frequently used was controlled by an iron water pipe rheostat of ten equal sections in series, having a total resistance of 0.5 ohm. With all but one section of the rheostat short-circuited, 600 amperes was delivered at a pressure of 80 volts at the furnace terminals. Of the total energy transformed by the generator, the per cent delivered to the furnace was as follows:

Average for an entire experiment........68 per cent
During maximum load (600 amperes by 80 volts) ....73 per cent
Highest per cent for ten consecutive minutes in any experiment.................80 per cent
Highest per cent ever attained, for two minutes, by running the furnace directly from the dynamo....................94 per cent

The furnace was started with the entire rheostat in the circuit, which explains the low average. In experimental work, the convenience of this method of control more than compensates for the waste of energy. This waste of energy might be considerably diminished by having some sections of the rheostat of one-half and one-third the resistance of the others, with a generator voltage of eighty or ninety, instead of one hundred and ten.

It is stated by Mrs. Ayrton "without some external resistance, it is impossible to maintain a silent arc between solid carbons." From the behavior of the arc when the resistance of the rheostat was reduced to only 0.05 ohm, the writer believed that even this resistance might be dispensed with, and yet the arc would run steadily. This was verified by an experiment. The furnace was heated, as usual, with the line voltage at 110. The voltage regulator was then cut out, the voltage lowered to 70, and the last section of the rheostat short-circuited. The only resistance external to the arc was that of the cables and armature—between 0.012 and 0.018 ohm. The arc ran satisfactorily, although not so steadily as with one section of the rheostat in the circuit. The voltage of the generator was then raised to 80 with the result that the widest variations of current for an arc one and seven-eighths inches in length was from 310 to 450 amperes. It is probable that most of this variation was due to the defective form of the anode, developed during the preliminary heating. The average resistance of the arc was twelve times that of the remainder of the circuit, and consequently the per cent of energy delivered to the furnace was 92+.

In this experiment, it was observed that when the arc became silent after it had been "shrieking," the voltage across the terminals diminished and the current increased. This is contrary to Mrs. Ayrton's observation upon the open arc.

These differences between the action of the arc lamp and the arc furnace would undoubtedly yield interesting results if thoroughly investigated.

Electric Furnaces.

For the production of metallic borides and silicides by the direct reduction of oxygen compounds, the horizontal arc furnace was decided upon as most easily managed and best suited to the purpose.

Several different materials of construction were tried and rejected. Finally magnesite brick was decided upon as being by far the most resistant material available for the furnace. Other materials tried were limestone, ordinary fire brick, chromite, and silica brick. The only limestone obtainable was very easily broken, and as a furnace material cracked badly, even when protected from the arc by a graphite lining. It is quite possible that a harder, stronger limestone, and particularly a dolomite, might prove a satisfactory material for furnace construction. Ordinary fire brick cannot be used for the inner zone of an arc furnace because of its fusibility. Silica and chromite brick, while less fusible than fire brick, are still far from satisfactory. The former fuses and disintegrates by the heat of the arc, and the latter cracks badly before its fusing point is reached. Both are distinctly more fusible than magnesite brick, and are more readily attacked by slags.

In point of infusibility, magnesite bricks are very satisfactory, being melted to a depth of less than one-fourth inch by ten minutes exposure to an arc of 600 amperes at 80 volts only an inch below the brick. They do, however, crack under the influence of heat, and must be handled very carefully. These brick were obtained from the Harbieson-Walker Refractories Company.

In form, the furnaces consisted of a box built of magnesite brick without cement, surrounded by a second layer of fire brick. The dimensions of the horizontal arc furnace were: outside—20 inches square, 26 inches high; and inside—8¾ inches long, 7 inches wide, 7 inches deep—429 cubic inches. The outside dimensions included the ventilated base of fire brick. Although the table on which the furnaces stood had a thick cement top, it was found necessary to have air circulation between the body of the furnace and the table top.

The cover consisted of two magnesite bricks, and the electrodes entered through holes drilled in the bricks which formed the ends. Later, the ends were simply built up around the electrodes, and the cracks stuffed with asbestos paper. This type of furnace, with two modifications, was used in about 130 experiments.

Much trouble was experienced from the contamination of the products by iron. Even after all materials that entered into the composition of the charges were rendered iron free, the iron was still found, and its source was finally discovered to be the magnesite brick. A fused metal resting upon these in the presence of a strongly reducing slag, will be contaminated by iron. To remedy this, a bed of powdered magnesia, free from iron, was spread an inch deep in the bottom of the cavity. This prevented any contamination from the bottom of the furnace, but there was still occasional contamination from the side walls. For a part of the work, the entire inside, except for the bottom and the upper half of each end, was lined with inch-thick sheet graphite. Although this introduced carbon, it effectually prevented contamination by iron, and greatly prolonged the life of the magnesite brick. With the graphite lining, the inside dimensions were eight and three-quarters inches by five inches by six inches—262 cubic inches.

It would have been an advantage if the bottom of the furnace had been laid in cement, or strapped with iron to prevent the bricks from separating with the alternate expansion and contraction.

For the short duration of the heating, fifteen to twenty minutes, with a powerful current for less than half this time, the heat insulation was found to be ample. The outside layers of brick could be removed by the bare hands, if done as soon as the current was shut off, although an hour later they might become red-hot. The nearer air-tight the furnace is, without actually being so, the better.

The electrodes used were of Acheson graphite. The maximum current permissible on account of oxidation of the elec-

trodes outside of the furnace has been determined in the course of this work to be as given in the following table for twenty minutes heating:

Table IV.

Diameter.	Amperes.
1 inch.	400+.
1¼ inch.	650+.
1½ inch.	900.
2 inch.	1600.

The capacity of the first two sizes is from direct measurement; that of the last two is calculated from the areas of their sections, since the maximum current used, 700 amperes, never heated them to redness. If the heating is prolonged to an hour or more the current allowable is about 15 per cent less than in Table IV.

Although 600 amperes has been used for a short time with one inch electrodes, these become red their entire length, and undergo oxidation. It was found that this oxidation could be prevented by painting them with a paste of water glass and carborundum dust.

Moissan ("Le Four Electrique") has given the size of carbon electrodes suitable for furnaces of different horsepower. As he ordinarily used fifty or sixty volts, the latter value has been used in calculating the following table, except in one case where he specified seventy-five volts. The results as calculated from Moissan are given in Table V.

Table V.

Diameter. m. m.	Diameter. Inches.	Amperes.
16-18	11/16	120
27	1	450
40	1½	1,250 (100 H. P.)
50	2	3,700 (300 H. P.)

In this table the current densities per unit area increase greatly with increase of diameter, although from the fact that the radiating surface increases less rapidly than the cross section, the reverse would be expected. Either the capacity of the smaller electrodes is greatly underrated, or that of the larger ones much overrated. The only carbon electrode tried by the writer was of one inch diameter, and this became red-hot outside the furnace at 150 amperes, although Moissan stated that he was able to use 450 amperes. It would be of interest to the worker with the electric furnace to know whether the relative conductivities of carbon and of graphite for heat are in the same ratio as their electrical conductivities, as is the case for the metals. If this is so, there will be no advantage of either over the other in regard to the amount of heat wasted by conduction from the furnace.

On account of their being such good conductors of heat, the graphite electrodes used should be the smallest that will carry the desired current. They should be slightly pointed before use, and set exactly in line in the furnace. The source of any irregularity in the operation of the arc is usually found in the anode, which corrodes irregularly, while the cathode keeps in good order without attention. One advantage of alternating over direct current for the arc furnace is that both electrodes tend to keep in good form.

In this series of experiments many observations were made upon the length of arc, its variation in resistance, electrode consumption, etc. Some of these observations are included here as of interest, and perhaps of value to other experimenters.

The longest arcs obtained were 15.5 and 14.4 centimeters (6 1/2 and 5 11/16 inches) at 104 volts, the former at 800 amperes. At the usual voltage of 80 on the furnace terminals, the length of arc for 600 amperes varied from 6 to 7.5 centimeters (2⅜ to 3 inches) as a rule.

Resistance of the arc depends upon:

a. Length.

b. Current strength. (See Table VI.)
Increase of current increases the cross section of the arc.

c. Temperature of the furnace.
During the rise in temperature at the beginning of an experiment the arc must be gradually lengthened if the current is to be maintained constant. When a cold charge is fed into a hot furnace the current is diminished.

Table VI.—Effect of varying currents upon the resistance of the arc.

No. of Experiment.	Amperes.	Volts.	Resistance.	R :R
98	600	75	.118	1
	360	75	.202	1.71
	210	79	.369	3.12
	190	82	.425	3.60
	150	81	.533	4.51
	140	83	.586	4.96
	120	79	.651	5.51
	120	81	.668	5.66
	100	81	.803	6.80
	70	80	1.136	9.62
	55	85	1.538	13.03
	40	92	2.293	19.43
111	580	78	.127	1
	400	72	.173	1.36
	330	77	.226	1.78
	280	77	.266	2.09
	200	81	.398	3.14
	160	81	.499	3.93
	200	76	.373	2.94
	180	66	.359	2.83
	150	77	.568	3.18
	120	75	.618	4.87
	130	75	.569	4.48
	120	70	.576	4.53
	120	70	.576	4.53
	110	71	.638	5.02
	75	83	1.099	8.66
	70	80	1.136	8.95
	80	89	1.105	10.97

d. Quantity and nature of vapors within the furnace.
An increase in the amount of vapors of sodium and of silicon lowers the resistance. Possibly there are vapors which are capable of increasing the resistance.

The data of Table VI were taken at the close of experiments when the furnace was very hot. Maintaining the length of arc unchanged, the current was cut down by increasing the external resistance. The pairs of bracketed readings were made about ten seconds apart with the same resistance in the circuit. An entire set of readings occupied about three minutes, so that the temperature within the furnace was practically constant. The column R_1:R, shows the increase in resistance of the arc as the current is diminished and the external resistance is increased.

From the above and other similar data the writer draws the conclusion that **the arc tends to maintain a constant ratio between its own resistance and that of the remainder of the circuit, or an arc of fixed length tends to maintain a constant voltage.**

In experiment 111, the external resistance was varied about 900 per cent, the maximum variation in voltage of the arc was 14.1 per cent, and the average, only 1.8 per cent. The rise in voltage seen in the last readings, occurred but a few seconds before the arc died out. One readily pictures the shrinking of the arc to a mere pencil of carbon vapor as the current is diminished.

The above records were made after the vigor of the chemical reaction was over, for at the height of the reaction

the fluctuations of the instruments were usually too rapid to be read.

Table VIII.—General Data Concerning the Arc Furnace.

Exp. No.	Diam. of Electrodes.	Average K. W.	Time in Min.	K. W. x Min.	Volts.	Amp.	Length of Arc. Inches.	Length of Arc. C. M.	Resistance. Total.	Resistance. Per inch.	Resistance. Per cm.
129	1½	28.0	36	1008	104	800	6 1/8	15.5	.123	.020	.0079
61	1¼	30.5	12	366	80	.600	3 3/4	9.5	.126	.034	.0132
121	1½	28.6	30	859	81	550	3 13/16	9.6	141	.037	.0147
123	1½	28.6	61	1521	78	570	3	7.7	.130	.043	.0169
88	1¼	24.2	28	696	78	560	2 3/4	7.0	.133	.048	.0190
150	2	21.8	45	980	68	650	2	5.05	.098	.049	.0194
86	1¼	33.3	15	500	75	600	2 1/4	5.7	.118	.055	.0207
89	1¼	18.1	38	687	70	400	2 7/8	7.3	.168	.058	.0230
99	1¼	28.7	14	402	76	600	2	5.05	.120	.060	.0238
09	1¼	26.0	25	670	80	550	2 1/8	5.4	.138	.065	.0255
04	1¼	31.1	8	249	79	550	1 3/4	4.4	.118	.068	.0268
94	1¼	24.7	10	247	82	500	2 3/16	5.6	.157	.072	.0280
100	1¼	26.1	14	414	78	600	1 11/16	4.3	.123	.073	.0286
107	1¼	29.9	23	482	80	300	2 7/8	7.3	.259	.090	.0350
*127	1½	28.1	45	1264	103	150	5 11/16	14.4	.679	.119	.0470

*The current was cut down from 400 amperes to 150 by drawing out the arc instead of increasing the external resistance as usual. This is responsible for the abnormal resistance found.

The effect of an increase of current in lowering the resistance of the arc has already been pointed out; the other factor appears to be the temperature, estimating this from both the average and the total energy delivered to the furnace.

As has been already stated, the source of trouble when the arc is unsteady is to be found at the anode, and seems to the writer to be due to insufficient heat to maintain there a layer of carbon vapor.

There is a deposition upon as well as a vaporization of each electrode. The points of each are coated with smooth, lustrous graphite of extremely fine grain. There are two separate arcs. Each half of the current wave has its own exclusive territory on the electrodes. Each arc dies out with reversal of current; yet sufficient carbon vapor remains in its crater so that when this electrode is once more anode, the path of least resistance is from the crater rather than from any other part of the electrode. This phenomenon occurred only with a low voltage and large electrodes, and would seem to be possible only when the crater of the anode during each phase is small in comparison with the area of the end of the electrode.

Observations were made upon the loss in weight of graphite electrodes during several experiments. The results are given in Table IX.

Direct current was used in all except the first two experiments. These are marked A. C. and to them the terms anode and cathode do not apply. In these the electrode losing the more in weight extended into the furnace much farther than the other.

Electrode losses seem to be due to three causes:

1. Volatilization from the crater, confined to the anode.
2. Oxidation.
3. Disintegration—particles fall from the electrodes.

(1) is independent of, (2) and (3) dependent upon, the length of electrode within the furnace. The total loss is diminished about 50 per cent by filling the furnace with illuminating gas; this can diminish only (2) and (3). The losses with 2-inch electrodes were double those with 1½ inch diameter. This points again to the use of the smallest possible electrodes. It should be stated, however, that only a single pair of 2-inch electrodes were tested.

Table IX.—Loss in weight of electrodes.

	Exp. No.	Diameter of electrode.	Time.	Average K. W.	K. W. x time.	Loss in Grams. Total. Anode.	Total. Cathode.	Ratio. An. Cath.	Per minute. Anode.	Per minute. Cathode.	Per average K. W. Anode.	Per average K. W. Cathode.	Per K. W. minute. Anode.	Per K. W. minute. Cathode.
		Ins.												
A. C.	150A	1	37	6.9	229	17	14.3	1.19	.46	.40	2.40	2.35	.074	.062
A. C.	151B	1	60	11.6	695	28.8	19.6	1.47	.48	.32	2.48	1.69	.041	.028
D. C.	151A	1	9	13.4	120	11.3	2.02	5.13	1.24	.23	.84	.16	.094	.019
	139	1½	22	23.7	632	16.3	20	.81	.71	.87	.59	.72	.026	.031
	136	1½	58	25.1	1,457	59.3	32	1.87	1.02	.55	2.33	1.23	.040	.022
	138	1½	39	32.2	1,266	54.2	17	3.19	1.39	.44	1.68	.52	.043	.013
	137	1½	55	28.4	1,561	82.2	43	1.93	1.51	.78	2.91	1.51	.053	.028
	140	1½	22	23.7	523	49.0	15	3.27	2.23	.68	2.07	.63	.095	.029
Average ...	....	......	.....	....	....	52.3	25	....	1.37	.66	1.92	.92	.051	.025
	152	2	57	20.8	1,186	103.8	37.6	2.72	1.82	.66	4.98	1.81	.105	.038
	148	2	27	31.3	845	166.2	70.2	2.37	6.20	2.96	5.31	2.24	.197	.083
Average ...	....	......	.....	....	....	135	53.9	....	4.01	1.81	5.15	2.03	.151	.061
Furnace filled with illuminating gas	141	1½	38	31.4	1,142	23.5	10.4	2.26	.62	.27	.76	.33	.021	.009
	150	2	45	21.8	980	42.8	15.9	2.69	.95	.35	2.00	.73	.043	.016
	155	2	64	26.5	1,894	82	73	1.12	1.34	1.14	3.09	2.75	.043	.038
	151	2	46	14.2	656	56.1	9.3	6.03	1.22	.20	3.95	.65	.085	.014
	147	2	22	19.5	430	40.8	32	1.27	1.85	1.45	2.04	1.60	.095	.074
Average ...	....	......	.....	....	....	55.4	32.5	....	1.34	.78	2.77	1.43	.066	.035

DENATURED ALCOHOL: ITS PRODUCTION AND USES.*

Arthur H. Bosworth.

The law which permits the use of denatured alcohol has not long been in force. On May 24, 1906, the United States Senate passed the Denatured Alcohol Bill by unanimous vote. The bill had previously passed the House, after some opposition by the wood alcohol interests, and a few days later the signature of the President made it a law. Thus successfully ended the agitation for tax-free alcohol for use in the arts and industries, which began in 1888 and had continued intermittently for eighteen years. The passage of the law resulted from the effort of a manufacturer's committee organized to promote this legislation.

The law is a very important one for two reasons: it interferes with the domination of the oil trust over the supply of liquid fuel for heat, light and power; and it secures to the manufacturer the use of a valuable industrial agent. It provides that after the first day of this year alcohol produced under governmental supervision may be taken free of tax from bonded distilleries and warehouses for industrial purposes after being "denatured," by the addition of some substance which prevents the use of alcohol as a beverage.

The Wilson Bill, passed in 1894, provided for tax-free alcohol in certain industries, but the law was so defective that under its provisions it was impossible to provide tax-free alcohol and yet safeguard the revenue that the Government derives from taxes on alcohol used as a beverage. David A. Gates, for thirteen years an officer in the Internal Revenue Department and one of the experts who assisted in drawing up the Denatured Alcohol Bill, says that of the $750,000,000 in taxes, including postal revenues, raised by the Government annually, nearly 20 per cent ($150,000,000) comes from distilled spirits. Thus, although the need for tax-free industrial alcohol was great, it was impossible to jeopardize such a large part of our national income by providing such alcohol under the Wilson Law.

As the extent to which denatured alcohol will be used depends largely upon its cheapness, let us consider what it will cost to produce a gallon of denatured alcohol. This depends on the substances from which the alcohol is made and also on the substances used to denature it. Alcohol for use in the arts must be produced under Government supervision, but as the expense of this supervision is borne by the Government, it does not enter into the cost of production of the alcohol. Perhaps this cost can be understood more clearly if a few facts regarding the manufacture of alcohol are given.

Alcohol, C_2H_5OH, is composed of the elements, Carbon, Hydrogen and Oxygen combined in invariable proportions. As yet chemists have discovered no way of producing alcohol directly from its elements, although they have succeeded in making it from calcium carbide or barium carbide by indirect synthesis.

The commercial sources of alcohol, however, are fruits, starches, grains, and sugar producing vegetables.

"The raw material necessary for a gallon of alcohol 188 proof is 4.5 bushels of fruit, 0.36 of a bushel of grain, or 2 gallons of molasses. In the distillation of fruit and molasses there are no by-products: the first cost of alcohol produced from fruit or molasses therefore is the cost of the raw material, the labor, and the interest on the investment. The by-products at a grain distillery (stock feed and fusel oil) will pay the cost of operating, the labor and the interest on the investment. The cost of alcohol produced from grain is therefore represented in the price of the grain." (D. A. Gates in the January "World Today").

In Germany one of the greatest sources of alcohol is potatoes, and it has been found that one ton of potatoes yields 25 gallons pure alcohol.

If the source of alcohol is a starchy substance the material is ground up, steamed, and then mixed with malt and water at a temperature of 150 degrees Fahrenheit. Fermentation is then accomplished by brewers or compressed yeast, or by adding a saccharine liquid. The fermentation is carried as far as possible, so as to obtain the greatest amount of alcohol from the mixture. The liquid thus obtained is distilled. The product of the first distillation is impure, containing water and oils that have passed over from the still to the receiver along with the alcohol, and redistillation is necessary; unless one uses the method of combined distillation and rectification devised in 1900 by Edward Adam. This more modern method is described in an interesting article by M. Bandry de Saunier in a recent Scientific American Supplement.

It has been estimated that the average cost of a gallon of denatured alcohol to the consumer will be from 18 to 22 cents. In Germany, in the year 1902, 90 per cent alcohol sold for 11.5 cents per gallon, in 1905 the price advanced to 19 cents, the rise being accounted for by the fact that an alcohol trust controlled the market. In Louisiana, and a few other States, where crude "black-strap" molasses, a by-product of sugar manufacture, sometimes sells as low as 3 cents a gallon, in Nebraska, where the price of corn occasionally falls to 30 cents per bushel, or in localities where the soil is especially adapted to the growing of potatoes, the cost of production of alcohol may be no more than 10 or 11 cents per gallon. A prominent beet sugar manufacturer estimates that alcohol can be made from the waste of the beet sugar industry for 10 or 12 cents per gallon. Mr. G. A. Burns, a dentist of Los Angeles, suggests in a letter to the Scientific American that cactus is a cheap source of alcohol. Knowing that the natives of New Mexico make an intoxicating liquor from cactus, Mr. Burns experimented and, in a crude way, distilled one gallon of alcohol from five pounds of cactus. Cacti plants, he says, can be cut down, ground up, and put through the process of fermentation and distillation like corn, wheat, or barley He adds that Nevada cactus grows from two to five feet high very quickly and two months after being cut down it would grow up from the stubble and be ready to again produce industrial alcohol. Since in the West cactus grows abundantly and without irrigation or other attention, this may be one of the cheapest sources of industrial alcohol. The sources from which alcohol is made differ in different sections of the country. Either cactus, grain, molasses, fruit, or potatoes might be used, but economy decides the matter.

As was stated above, the cost of denatured alcohol will depend also on the cost of the denaturant. In some cases a substance essential to the manufacture of a certain article might be used to denature the alcohol, and as this substance would be needed in manufacturing the article anyway, its cost should not figure in the cost of the alcohol. However, in general, the cost of the denaturants must be a factor in the cost of production of denatured alcohol. The formula for denaturing the alcohol, given by the United States Internal Revenue Commissioner, is as follows: "To 100 parts ethyl alcohol add 10 parts approved methyl alcohol and one-half of one part approved benzine." Formulae of special denaturants are to be submitted to the Commissioner of Internal Revenue, who announces what formulae may be used.

The greatest need now is for an improved denaturing process. Methyl, or wood, alcohol is considerably more expensive than alcohol itself; and pyridine, another substance extensively used in Europe for this purpose, is far from cheap and has a very disagreeable odor. It is hoped that Yankee ingenuity will invent a cheaper and more agreeable process that is equally efficient. The following table, taken from an article by Mr. H. Diedericks in the "Scientific American Supplement No. 1596," shows what substances are used as denaturants in Europe. As several of the countries seek to keep their formulae secret, the table is based on analyses:

*From the Yale Scientific Monthly.

Materials Used to Denature Alcohol.

Country.	Sp. Gr. of Denatured Alcohol at 15 C.	Methylene (Wood Alcohol) and Impurities.	Pyridine, or Pyridine Bases Per Cent.	Acetone Per Cent.	Benzol Per Cent.	Benzine Per Cent.
France.	0.832	7.5	....	2.5	....	0.5
Germany.						
Denat. Alc..	0.819	1.5	0.5	0.5	....	....
Motor Alc..	0.825	0.75	0.25	0.25	2.0	....
Austria.						
Denat. Alc..	0.835	3.75	0.5	1.25	....	....
Motor Alc..	0.826	0.5	trace	trace	2.5	....
Russia	0.836	10.	0.5	5.	....	....
Italy.						
Motor Alc..	0.835	6.5	0.65	2.0	1.0	....
Switzerland. .	0.837	5.	0.32	2.2	....	....

It should be noticed that the formula used in this country differs from any given above, as it contains no pyridine, acetone or benzol, and calls for a higher per cent of methyl alcohol than does the formula of any other country excepting Russia.*

There is a great variance in the estimates of the quantity of industrial alcohol that will be used annually in this country. The wood alcohol interests that opposed the bill in the House asserted that less than 10,000,000 gallons will be consumed, while a few enthusiastic supporters of the measure predict that in a short time the annual consumption will reach 200,000,000 gallons. All such estimates are largely a matter of speculation, but an idea of the amount may be obtained by considering more particularly the use of industrial alcohol. Its uses for power, heating and lighting purposes have been mentioned. Alcohol burns with a pale blue flame that is intensely hot. In alcohol lamps for illumination there is a mantle, similar in manufacture and appearance to the mantle in a Welsbach gas lamp, which is heated to incandescence by an alcohol flame. Such lamps give a light equal to gas lamps in brilliancy, and as the products of combustion of pure alcohol are simply carbon dioxide and water, they are more sanitary than lamps which allow gas to escape into the room. In Europe there are many kinds of stoves for heating and cooking purposes that use denatured alcohol as fuel. Recently an alcohol flat-iron has been invented.

About six months ago at the General Electric Company's works in Lynn, a test was made of a Dentz alcohol engine (made in Germany) that was to be coupled to a dynamo and sent to Cuba, where cheap Cuban alcohol—costing about 12 cents per gallon—will be used. Alcohol engines are internal combustion engines and are similar to gasoline engines, the main difference being that compression is carried to a point greater than is possible with gasoline and a different vaporizer or carbureter is used. The results of the experiments with the Dentz engine proved these three things: The combustion is clearer with alcohol than with gasoline; alcohol is suitable for use in motors even when it contains 15 per cent water; and although a gallon of alcohol has fewer heat units than a gallon of gasoline, it develops about the same amount of power, because it can be compressed more without danger of premature explosion and less heat is lost in the exhaust gases and the heating of the water jacket. Most authorities agree that the efficiency of alcohol engines is probably greater than that of engines using any other fuel for internal combustion. There may be some room for improvement also in this respect because of the newness of alcohol engines.

Thus we see that alcohol is entirely suitable for use in engines, whether or not it will be generally substituted for gasoline depending mainly on the relative prices of alcohol and gasoline. The supply of gasoline is controlled by a trust. Should trust prices be forced to a certain point which is not far above the price of gasoline today, alcohol could profitably compete with gasoline. This phase of potential competition should have a checking influence on the price of gasoline; thus whether or not alcohol displaces gasoline as engine fuel, the general public is benefited in one more way by the passage of the Denatured Alcohol Bill. Gasoline sells at retail for 50 cents per gallon at Goldfield and Tonopah, Nevada, and the price in most of the States west of the Missouri River and north of Texas is between 19 and 25 cents per gallon. Since denatured alcohol can be produced in many of those States for 12 or 15 cents per gallon, because they are extensive producers of corn, sugar or other vegetable products suitable for the cheap manufacture of alcohol, it is not unreasonable to suppose that gasoline may in many localities be displaced by our new industrial agent.

Even at a slight increase in cost, there are reasons why alcohol would be preferred to gasoline as an engine fuel. The exhaust gases of kerosene or gasoline are objectionable because of their odor. The exhaust from alcohol is neither smoky nor evil smelling. A rich mixture of gasoline and air gives a smoky, bad smelling exhaust, while the alcohol exhaust is not disagreeable even when there is a considerable excess of vaporized alcohol for air. This property of alcohol is of some importance when there are good sized stationary engines running a number of hours consecutively and exhausting into a populous neighborhood. The use of alcohol as a fuel is safer because it is not inflammable and an alcohol fire can be extinguished by water. As gasoline floats on water and does not mix with it, water is not effective in putting out gasoline conflagrations. There are numerous restrictions imposed by insurance companies on the storage and use of gasoline. The conditions imposed on the storage and handling of alcohol are less strict and the cost of insurance is lower. These considerations have caused alcohol to displace gasoline in some European localities where alcohol costs a cent or two more per gallon.

In conclusion, let us glance at a list of a few commodities in the manufacture of which alcohol is used. The complete list would be a large one, comprising upwards of 100 articles. It was stated above that the making of coal tar and aniline dyes in this country will be stimulated by the use of denatured alcohol. The introduction of the tax-free industrial alcohol will bring a new industry here, the manufacture of artificial silk from cotton by a process now in use in France. The representatives of a French company so large that its plant uses 6000 gallons of alcohol daily in producing artificial silk stated before a committee of the House of Representatives, when that body was considering the Denatured Alcohol Bill, that if the bill became a law their company would establish a factory in this country. Their experience had shown them that America offered the greatest market for their silk. With cheap cotton, cheap alcohol, and a large demand for the silk, this new industry will probably become an important one.

Denatured alcohol is also used in the manufacture of smokeless powder, hats, shellac, varnish, celluloid, furniture, paints, electrical apparatus, transparent soaps, picture mouldings, and in the curing of tobacco. In the past the high tax on grain alcohol forced manufacturers to use wood alcohol to the extent of 7,500,000 gallons annually in making some of these articles. But as wood alcohol sufficiently pure for this purpose costs about 70 cents per gallon, there is no doubt but that denatured alcohol will entirely displace it. This results in a saving to manufacturers, and in some cases will lower the cost of the articles to consumers. This, however, is not the greatest advantage of this substitution of solvents. There have been a number of well authenticated cases of wood alcohol poisoning—even loss of eye-sight—due to the continued inhalation and absorption of this poison by persons employed in factories where wood alcohol is used. Suffering, therefore, will also be prevented by the use of denatured alcohol in the arts and industries.

*For a comprehensive digest of the portions of the Denatured Alcohol Law of interest to distillers and to proprietors of denaturing plants see "Scientific American Supplements," Vol. 62, pages 25754, 25758-9, 25778-9.

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EDITORIAL.

Illumination

In no field of physical science are the standards and methods of measurement so unsatisfactory as in the realm of lighting and illumination. The unit of light, the candle power, is most misleading. This is largely due to the fact that under almost all conditions it is not only light that is wanted, but illumination.

When any form of lighting has its magnitude expressed in candle power, many important factors are left out. With the candle power a certain definite amount, the color of the light may increase the efficiency of the source of light as an illuminant enormously. The converse is equally true that with a constant candle power some other color of light may decrease its utility to an equal degree. The color of light is of importance, yet there are other features which must be given even greater consideration. For a number of years it has been recognized that rarely is a certain amount of lighting required, but rather a satisfactory degree of illumination. The color of the walls and ceilings of a room will have as much to do with the proper lighting and its distribution as the character of the lights themselves, their location and the quality of light available.

Any one who has worked in a photometer room is familiar with the effect of a single source of light in a space absolutely dark, there being no reflection of light from surrounding objects. When a lighted candle is taken into a dark tunnel, the walls of which are very dark or even black, the same effect is produced. When one is near the candle light it seems that the darkness is so intense that the light does not penetrate it except very slightly. The same candle in a room with absolutely white walls, with curved ceilings and no corners or openings, will produce a degree of illumination which is a surprise to the one experiencing these two very elementary experiments.

It is therefore obvious that the decorations and arrangements of ceilings or shape of the reflecting walls and the color of the furnishings of the room must all be given as careful treatment as the distribution and number of lights.

In the early days of the constant current open arc lamp, the amount of light from the 10 ampere arc was supposed to be 2000 candle power. The actual number of watts for each arc was approximately 450. This gives an efficiency of light expressed in candle power per watt far above that of any other form of light which may be produced by the electric current. It was soon found, however, that in reality the 10 ampere arc does not give 2000 candle power with a consumption of 450 watts; that while the light emitted from the crater of the upper carbon is exceedingly intense, yet over the entire lower hemisphere the light from the direct current open arc is not uniform, and lucky indeed is the man who can find from such a direct current open arc 2000 candle power in any part of the field illuminated. The introduction of the enclosed arc lamp, both direct and alternating current was seemingly a step backward in the efficiency of the lamp as expressed in watts per candle power. As an illuminant, however, due largely to the fact that the source of light was enlarged from a mere point to a comparatively large surface, the enclosed arc lamp was found to be better for general illumination than the open direct current arc.

A single filament incandescent lamp of the old style with the filament in the shape of a hair-pin is open to the same objections, but to a less extent, as the open arc lamp. A very decided improvement resulted in increasing the luminous surface of the filament of the incandescent lamp by the use of a coil of one or more turn in place of the U-shaped filament. It must, however, be admitted that the incandescent lamp, notwithstanding its wide application for lighting and illumination, is not as satisfactory as some other sources of light.

The flat open gas jet with its flickering, due to currents of air, even when surrounded by globes, is of course very unsatisfactory. The amount of heat given off from such open jets is an additional source of annoyance and inconvenience. The forms and types of gas lamps which are in use today, however, are much superior to the incandescent lamp in color and in the magnitude of the illuminating surface which constitutes the source of light. An incandescent lamp will flicker unless the voltage supplied to the terminals of the lamp is absolutely uniform. The diffi-

culty involved in maintaining the voltage sufficiently constant when current for both light and power is required, is increased enormously as the size of the systems of transmission and distribution are increased.

For certain uses, such as reading or microscopical work where the eye is necessarily concentrated on a small surface, the coal oil lamp with suitable shade cannot be excelled by either gas or electricity.

A most interesting field, as yet commercially undeveloped, lies in the illumination of rooms, stores and galleries with vacuum tubes in which electrical discharges at high voltages are taking place. The absence of heat, the exceedingly satisfactory color of the light and the large surface constituting the source of light, all tend to make the illumination from such tubes exceedingly satisfactory. With a considerable number of tubes properly operated the variation in the magnitude of the light emitted is exceedingly small.

While it is probably not the engineers' field of operation, yet a proper consideration of the distribution of light as well as the color of the walls and surroundings should always be given by those interested in the progress and development of lighting from any source, no matter whether arc lamps, incandescent lamps, luminous tubes or gas burners of any type may be in service.

ORDER OF REJUVENATED SONS OF JOVE.

A number of gentlemen interested in the various branches of the electrical trade met at an informal lunch on April 6th, 1907, at Solari's Cafe, San Francisco, for the purpose of organizing a chapter of the Order of the Sons of Jove.

Mr. George A. Cole, No. 533, Jovian Statesman of California, presided at the meeting.

After the organization had been perfected, the following officers were elected for the ensuing year:

W. Martland, Jupiter; C. E. Wiggins, Mercury; R. S. Phelps, Vulcan; C. C. Hillis, Pluto; E. B. Strong, Neptune; A. E. Drendell, Mars; J. F. Hetty, Hercules; S. H. Taylor, Apollo.

After arranging for a rejuvenation at the Cliff House on Tuesday evening, April 9th, the meeting adjourned.

S. O. J. Rejuvenation.

Twenty-eight jolly Jovians met in conclave on April 9th, 1907, on the banks of Neptune's domain, the Cliff House, San Francisco, where ten candidates awaited their fate at the hands of Jupiter. We are proud to say there were none found with "short circuits," so that the emergency "cut-outs" were not necessary.

After a most sumptuous repast in which not the least enjoyable feature was the singing of the Jovian quartet, the banquet room was cleared for the ceremony. The following Tallow Dips were raised to Arc Lights that night:

F. E. Corwin, E. E. Elliott, W. L. Goodwin, Karl Woernecke, Chas. Brown, Frank Fowden, C. E. Winchell, W. R. Green, G. A. Young and Chas. M. Wood.

It fell to the lot of Messrs. Woernecke, Winchell, Green and Wood to do the Jovian honors, and right royally they succeeded. Pluto, for the nonce, reigned supreme. But when the sound of the gavel from Jupiter's realm, at eleven o'clock, rang the curtain down, and Pluto was relegated to his fiery furnace, there to remain until such times as other worthy Tallow Dips shall apply for admission into the Order, and his services needed again, the ceremonies were closed.

If the sentiments of good-fellowship expressed by the many that were present that evening is any criterion, the "Journal" predicts that the Order of the Sons of Jove will soon become one of the strongest organizations on the Pacific Coast. And we take the liberty of advising all good and true electrical advocates to join the Order at their earliest opportunity.

The permanent headquarters of the Sons of Jove have not as yet been decided upon, but they expect soon to have their own club rooms.

The charter members are as follows: A. E. Rowe, A. St. J. Bowie, F. H. Poss, J. A. Vandegrift, A. E. Skillicorn, H. C. Baker, C. E. Wiggins, A. M. Funcke, A. E. Drendell, C. McColgan, S. H. Taylor, E. B. Strong, H. C. Thaxter, J. F. Hetty, H. A. Sayles, W. R. Dunbar, J. R. Cole, J. H. McClellan, C. C. Hillis, W. I. Otis, T. E. Bibbins, R. W. Martland, R. S. Phelps, G. A. Cole, H. B. Carter and E. N. Fobes.

N. E. C. ASSOCIATION ANNUAL CONVENTION.

The seventh annual convention of the National Electrical Contractors' Association of the United States will be held in New York City, July 17th, 18th and 19th, inclusive.

Even at this early date all indications point to this convention being the most largely attended and probably the most interesting and entertaining in the history of the association.

BOOK REVIEWS.

Engineering Series of the University of Wisconsin, Bulletin No. 145, "An Investigation of the Borides and the Silicides," by Oliver Patterson Watts, Ph. D.

This paper presents the results of an experimental investigation of some of the compounds of the borides and the silicides which have become of scientific and commercial importance since the advent of the electirc furnace.

Bulletin No. 148 of the same series is the published results of a series of tests on "Reinforced Concrete," by Ernest Anthony Moritz, C. E.

In addition to the general observations on the action of reinforced concrete beams under stress, separate discussion is given to such particular phases of the subject as: The early appearance of minute cracks on the tension side of the beams; position of the neutral axis; efficiency of the different methods of reinforcing in preventing inclined tension failures; tests on sixteen 8x11-inch by 13-foot beams.

TRADE CATALOGUES.

The Allis-Chalmers Company has adopted the plan of issuing miniature bulletins (in addition to their regular publications) which are designed as envelope enclosures. This prohibits giving much detail of description regarding the various subjects; nevertheless, the reading of them will be sufficient to stimulate interest in the subject.

The H. W. Johns Manville Company is sending out a small folder descriptive of a new electric heater which it manufactures. It is convenient and inexpensive and furthermore has the approval of the National Board of Fire Underwriters.

AN AMERICAN DECORATION.

At the meeting of the Executive Committee of the American Institute of Social Service held this week at the Players' Club as the guests of Mr. Richard Watson Gilder, announcement was made that the Scientific American, through a desire to co-operate with the work of the institute in promoting an American Museum of Safety Devices, would give annually a gold medal to be awarded by the institute for the best device for safeguarding life and limb.

An advisory committee of the editors of the great technical papers was organized to co-operate with the institute in the work of protecting life and limb.

The Exposition of Safety Devices which was held by the institute in New York last month has been forwarded from the exposition at Chicago, where it was loaned for one week, to Boston for their exposition during the second week in April.

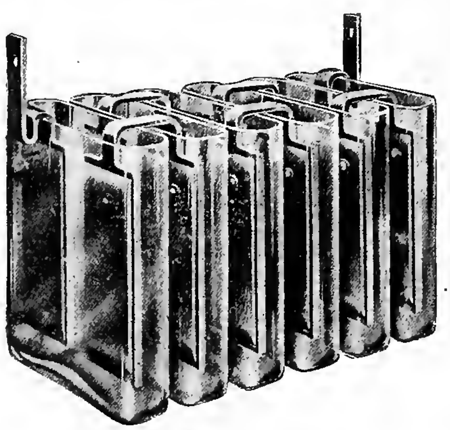
INDUSTRIAL

A NEW COUPLE TYPE STORAGE BATTERY.

In operating fire alarm and police signal telegraphs, private branch telephone exchanges and railroad signal systems only small amounts of current are required, but these are used on a closed circuit and absolute reliability of operation overrides all other considerations. Closed circuit work prescribes a low rate of discharge and freedom from polarization. As there is no primary cell of reasonable cost which is not seriously choked by polarization after standing on closed circuit for a few hours, this fact alone would cause storage batteries to be greatly preferred for such work. Furthermore, the experience of many years has demonstrated that the storage of secondary battery is superior to gravity and other forms of primary cells in requiring hardly more than one-third of the space for equal amperage, in freedom from the formation and creeping of salts in the jars, in requiring far less cleaning and attendance, in materially reducing the cost of maintenance and renewals of parts and in having a lower internal resistance as well as far more uniform voltage.

For the particular work of fire alarm telegraphs and similar installations, the most advantageous form of storage cell has been found in the "couple" type, which has no more than one pair of plates in each cell, as but small ampere capacity is needed while a low rate of discharge, accessibility of parts, and especially absolute certainty of action are essential.

Hitherto separators of insulating material have been placed between adjacent plates in all couple types of storage batteries, excepting those in which the plates are covered with hard rubber or celluloid envelopes, which practically act as separators. Though they are kept as thin as may be consistent with their office of preventing short circuits between plates, and though they are plentifully perforated, these separators necessarily obstruct free circulation of the electrolyte, which is of the utmost importance to the maintenance of voltage. This objection is inseparable from the types of cells in which plates are placed face to face in order to concentrate great capacity in a small space. In many types of these cells electrolytic action takes place at varying rates, in different parts of the same grid, producing local distortion, which causes the active material to drop out as sediment and necessarily shortens the life of the plate.



GOULD "TANDEM" COUPLE TYPE CELLS

Necessarily, the action between the positive and negative sides which face each other is far more intense than between the sides turned away from each other, so that charge and discharge take place mainly on the facing sides, producing a tendency to buckle and wear unevenly. All these defects are completely eliminated by placing the plates edge to edge instead of face to face, as shown in the new Gould "tandem" couple type here illustrated.

As all parts of both sides of both plates are exposed to exactly the same conditions of acid-supply and exposure to the electrolyte, charge and discharge proceed at the same rate in every part of the grid, which, owing to its peculiar "spun" construction out of hard rolled integral lead and its proportions of reserve lead base to active material, will retain its original capacity and shape intact for many years, no part giving way until the whole plate all over gives out by complete consumption.

The positive plate of each cell is permanently joined to the negative plate of its neighbor by broad, thick, substantial curved lead bonds, "burned" to the plates, so that no bolts are used except at the end of each row of cells. This permanent connection saves considerable time and trouble in assembling the battery, enables the plates to be quickly lifted out for inspection as well as for cleaning of the cell and avoids corrosion of bolted connections by sulphuric acid fumes, besides having practically negligable ohmic resistance. This construction presents many advantages, such as low internal resistance, perfect permanent connections, convenience and simplicity in handling, low first cost, accessibility for inspection, and, above all, absolute reliability of operation for use on fire alarm and police telegraphs.

It may be of interest that the fire department of one of the largest cities in this country has recently installed several batteries of these tandem couples and reports unusually satisfactory results. The Gould Storage Battery Company has on the press a very instructive booklet on "Couple Types of Storage Batteries," copies of which will be furnished to anyone interested.

To supply current for fire alarm and police signal telegraphs, railroad signal and similar systems, modern practice usually provides duplicate storage batteries for each separate circuit, so that one battery may be charged while the other supplies current for the circuit. This arrangement possesses the further advantage of keeping one battery in readiness at all times in case of accident to the companion battery, with sufficient capacity to allow a delay of sixty hours for repairs without serious inconvenience.

TWO BIG ALLIS-CHALMERS DIRECT CURRENT GENERATORS FOR THE BOSTON ELEVATED RAILWAY.

The Stone & Webster Engineering Corporation of Boston, prominent consulting and operating engineers, acting for the Boston Elevated Railway, recently placed contracts for two large Allis-Chalmers direct current railway generators, which rival in size and capacity any machines of a similar type in the country.

These machines, which are to be installed in the new extension to the Boston Elevated Railway Company's Lincoln Wharf station, on Atlantic Avenue, are to have a capacity of 2700 Kilowatts, 600 volts, and operate at a speed of 75 revolutions per minute. In this station is generated the larger portion of the current used for operating the elevated railway division and the cars through the East Boston tunnel.

The generators, which will be driven by vertical cross compound engines, will have armatures of such diameter that

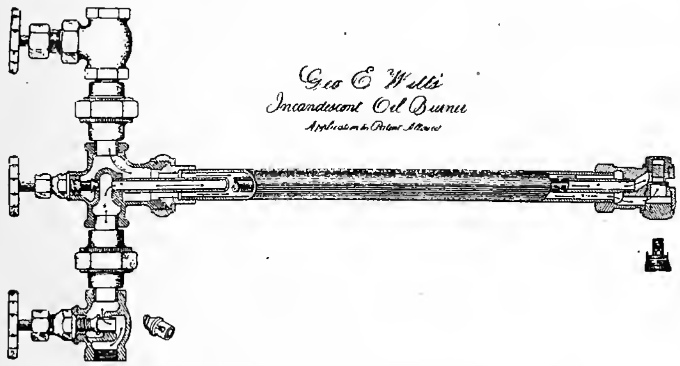
they will have to be built up on the ground. Each machine will have 32 poles; will have no band wires on the armature, and will be equipped with the Allis-Chalmers patented brush oscillating device, by means of which the brushes travel back and forth on the commutator in a direction parallel with the engine shaft, thus keeping the commutator in perfect condition and avoiding the usual wearing grooves.

FUEL OIL BURNERS.

The shortage of coal on the Pacific Coast during the past few months has given an added impetus to the use of crude oil for the generation of steam, although this kind of fuel had already replaced coal in the majority of plants in California.

The successful use of crude oil depends very largely on the type of burner installed. The "Little Giant" and "Incandescent" burners, manufactured by the George E. Witt Company, 530 Mission Street, San Francisco, have proven admirably efficient and reliable, and are entensively used by railroad and power companies and manufacturers. The "Little Giant" burner permits a ready adjustment for wide variations in load, produces a mild flame and is capable of close and delicate regulation. This type of burner is used to a large extent on the ferryboats of the Southern Pacific and North Shore railroads as well as on the locomotives and in the stationary plants of these and other Western roads.

The "Incandescent" burner includes two types. One of these is especially suitable for low oil pressures. The atomizer is of steel and interchangeable, and is fitted with a



ground joint which facilitates the separation of the steam and oil. The mixing partly takes place between the lips of the outer casing, thus preventing carbonization.

The other type of "Incandescent" burner is suitable for small vertical and horizontal boilers, for threshing machines, and where an oil pump is not used. It is a gravity burner and will operate on one pound of oil pressure.

A locomotive burner is also made by the George E. Witt Company which has the following features: The atomizer is interchangeable and can be adjusted to throw the flame in any direction. The atomizer is provided with three passages for the influx of the oil which cause it to spread evenly over the steam jet. The steam produces a partial vacuum on the oil, which is a great advantage where no oil pressure is employed.

This company has also devised a system of burning crude oil under low pressure for hot water heating systems, and also a noiseless retort furnace, which, it is claimed, will enable the boiler to hold steam for 48 hours after the furnace is thoroughly heated. Such a furnace obviously eliminates the use of a small auxiliary steam boiler for starting up the plant.

FORMAL OPENING OF THE NEW POWER PLANT AT CAZADERO.

The completion and throwing open to operation of the Portland Railway, Light and Power Company's new generating plant at Cazadero on February 26th was an event of not only absorbing local importance, but one of far-reaching interest to the State at large. That it was recognized as a notable event and one of wide interest is shown by the presence at the opening ceremonies of prominent State and City officials and of many distinguished private citizens.

When Mayor Lane, of Portland, in the presence of the president and officers of the Portland Railway, Light and Power Company, the engineers whose patient labors brought about the successful completion of the new plant, and the assemblage of distinguished guests, turned the switch which set in motion the great wheels in the power-house at Cazadero, that moment marked an eventful advance for the City of Portland. It meant that Portland's supply of electric power was more than doubled. It meant the completion of more than three years' labor and the expenditure of more than $1,000,000. It meant that the Portland Railway, Light and Power Company, following the broad-gauge policy advocated by its president and owners, and with unshaken faith in the ultimate supremacy of Portland as the commercial center of the Pacific Northwest, had backed its belief by the expenditure of this great sum to provide the company's customers with a service as nearly perfect as possible, and to make adequate provision for its rapidly increasing business, and the fast and continuous development of this city as a residential, mercantile, manufacturing and commercial center.

This power station, which is the largest electrical plant in the State of Oregon, is situated thirty-eight miles from the City of Portland, on the Clackamas river, and has a present output of 15,000 horsepower, which will be increased shortly to 25,000 horsepower, with the addition of two more generating units as originally planned.

About a mile above the power-house is the dam proper, which is 176 feet wide and 130 feet long at the base, and whose total length at the top is 400 feet. Here the water is taken from the Clackamas river through a bulkhead 17 feet by 25 feet and into a flume 2,622 feet long. This flume, which follows the contour of the hillside, discharges into a canal 2,898 feet long, 35 feet wide at the bottom, 20 feet deep and 75 feet wide at the top, which in turn empties into the main reservoir or lake.

The reservoir, which covers 50 acres when filled to an average depth of 20 feet, has a capacity of 326,480,000 gallons. When filled to this level the reservoir will supply power sufficient to run the wheels of the power plant below for six hours after the gates at the dam have been closed.

The forebay gates are located at the lower end of the reservoir and set in massive concrete walls built on the top edge of the river bluff. This wall, of steel and concrete construction, is 8 feet thick at the top and 20 feet thick at the bottom, built on foundations of sandstone bedrock. The water is led from the forebay gates to the power-house 138 feet below in tubes 8 feet in diameter, inclined at an angle of 45 degrees and lying along the hillside.

The power-house is of concrete construction 180 feet long by 54 feet wide, and in it is installed the necessary apparatus to double the supply of electrical energy to the City of Portland. The equipment is composed of three double 42-inch hydraulic turbine wheels of the Frances ype, to which are directly connected three Allis-Chalmers generators.

The three alternators are of the standard two-bearing water-wheel type with horizontal shaft. They have a normal rated output of 2500 kilowatts each, at a terminal pressure of 11,000 volts, three-phase. The revolving field has 12 poles and the speed is 330 revolutions per minute, thus giving a frequency of thirty-three cycles per second. Each alternator is equipped with a direct connected exciter, the armature of which is mounted on the end of the alternator shaft; the exciter field yoke is carried on an extension of the bed of the alternator. Bearings are of the ring oiling self-aligning type, water jacketed.

The stator yoke is of unusually stiff construction, being provided with heavy end heads, which serve to clamp the

laminations and at the same time reinforce the main part of the yoke. The laminations are of specially selected steel carefully varnished and assembled. The core is provided with numerous ventilating ducts, through which a strong blast of air is forced by the revolving field; the ventilation in these machines is exceptionally good, because of the high peripheral speed of the rotating part. The starting coils are very carefully insulated to withstand the high pressure for which these machines are wound, and they are placed in open slots; coils can thus be easily replaced in case of damage. The coils are securely held in the slots by means of wedges, and the end portions projecting beyond the core are so fastened that they cannot become displaced by abnormally large currents.

Because of the high peripheral speed, it is necessary to make the rotating part exceptionally strong. The spider is of cast steel, supporting a rim made up of steel laminations dovetailed to the spider arms and securely clamped between heavy cast steel end heads. The field poles are built up of steel laminations in the usual manner and are dovetailed to the laminated rim, being held in place by tapered keys. The field winding is of copper strip bent on edge and is designed for 120 volt exitation. Current is supplied to the field through cast copper collector rings and carbon brushes, the latter being held in brush holders supported from a suitable stand.

Tests on these machines showed that they were capable of carrying full load continuously with a rise in temperature less than 35 degrees centigrade, thus giving them a liberal margin for overloads.

With the completion of the water-power plant at Cazadero of 15,000 horsepower capacity, and with the plant at Oregon City, developing 12,000 horsepower and the steam plant in North Portland, 11,000 horsepower, the company now has available nearly 40,000 horsepower of electrical energy.

Inasmuch as the entire light and power load in Portland and vicinity, at the present time, is not more than 25,000 horsepower, there is about 15,000 horsepower of machinery in the Company's generating plants, to be held as reserve, in cases of emergency.

Almost the entire output of these generating plants is conducted by means of special tie lines to two principal sub-stations, one at Seventh and Alder Streets, on the West Side, and one at Knott Street and Williams Avenue, on the East Side. From these two sub-stations as distributing points, this power is carried by innumerable small feeders to various parts of the city and suburbs, for serving its customers with light and power, and operating the many street railway lines.

In addition to the above mentioned principal sub-stations, power is also distributed from sub-stations at Eagle Creek, Boring, Gresham, Lents Junction, Sellwood, East First and Harrison Streets and at St. Johns.

In order to prevent interruption upon its system, and therefore to insure continuity of service to its customers, it is necessary not only to have reserve machinery, in the generating stations, but also to have a duplication of transmission lines from these stations to the sub-stations, and between sub-stations, so that in case of the breaking of any one line, a reserve can be immediately placed in commission, and therefore the interruption to service, if any, would be but momentary.

With this idea in view the company has about completed the installation of such a duplicate system. From the plant at Cazadero, two separate and distinct transmission lines, by different routes, have been constructed, terminating at the sub-station at Williams Avenue and Knott Street. Similarly, from the plant at Oregon City, there are three separate lines to Portland, one on the East Side to the East Side station, and two on the West Side, to the West Side station.

This duplicate system of conducting lines has been installed also between the steam plant in North Portland and the sub-station at Seventh and Alder Streets, and between the East Side and West Side sub-stations. By such a duplicate system of connecting lines and with 15,000 horsepower of reserve machinery in the power-houses, the possibility of interruption to service upon the system is extremely small, for in case of serious trouble in any one station, or in case of interruption of any connecting line, there is always sufficient available reserve capacity, and always duplicate routes, by which the various distributing points may be served.

A second power plant, duplicating the Cazadero plant, is planned by the company and will be erected on the Upper Clackamas river, two and one-half miles above the new plant just opened at Cazadero. Work has been commenced clearing the ground and surveying for the new plant. The operations will be continued steadily and the company plans to have the new dam and station completed in about four years, at the end of which time the Cazadero plant will probably be used to capacity.

The station to be erected above Cazadero will develop 25,000 horsepower. These two plants on the Upper Clackamas will generate 50,000 horsepower, which, probably, with the resources already at the command of the company, will take care of every requirement of Portland for light and power for the next ten years.

A splendid water power is available in the Clackamas river two and one-half miles above Cazadero. Conditions are somewhat different than those prevailing at the power station just completed, and the dam to be built to develop the power at the upper station will be higher than the one on the river at Cazadero. A fall of 125 feet will be obtained, thus giving tremendous facilities for the generation of power. It is estimated that the new plant will cost about $750,000.

A COMMITTEE TO PREPARE STANDARD SPECIFICATIONS FOR INCANDESCENT LAMPS.

The Association of United States Government Electrical Engineers and a number of representatives of the leading incandescent lamp manufacturers of the United States held an unofficial meeting on February 25th, 26th and 27th at Washington, D. C. A set of standard specifications covering incandescent lamps used by the United States Government was discussed, the specifications as prepared being practically adopted, with the exception of a few minor points. These will be given further consideration by a committee, the make-up of which is about as follows: Dr. E. P. Hyde, Bureau of Standards; B. F. Fisher, electrical engineer, quartermaster's office; J. E. Woodwell, electrical engineer, Treasury Department; W. Y. Avery, Bureau of Equipment, Navy Department; P. L. Dougherty, electrical engineer, Treasury Department; W. C. Allen, electrical engineer, District of Columbia; S. E. Doane, National Electric Lamp Association; Jonathan Camp, Franklin Electric Manufacturing Company; F. W. Willcox, General Electric Company; Walter Cary, Sawyer-Man Electric Company; Edward Campbell, Germania Electric Lamp Company; R. W. Morgan, Anchor Lamp Company, and Preston S. Millar, Electrical Testing Laboratories, New York City.

ELECTRICAL DEVELOPMENT IN SOUTH AMERICA.

What is recognized as a signal victory in the development of South America is the fact that the government of Brazil has just granted permission to Messrs. Guinle & Company of Rio de Janeiro to sell electricity in the capitol city as well as other important cities in the republic. The contracts for light and power in Nictheroy and other cities along the proposed transmission lines have already been let.

The initial electric power sources will include several hydro-electric stations just being completed on various waterfalls controlled by Guinle & Company. These have an aggregate capacity of some 50,000 horsepower. The electrical equipment was furnished by the General Electric Company of New York. It is expected that work on the transmission lines will be started next June.

NEWS NOTES

FINANCIAL.

San Francisco, Cal.—The annual meeting of the Geary Street, Park and Ocean R. R. will take place at 1 p. m., April 10, at 1592 Geary Street.

Hanford, Cal.—The Niagara Oil Co. has declared an assessment of twelve cents per share, delinquent April 20, sale day May 10.

Richmond, Cal.—There will be a meeting of the stockholders of the Great Western Power Co. April 2, in the Bank of Richmond, here.

San Francisco, Cal.—An assessment of $2.50 per share, delinquent April 25, sale day May 15, has been declared by the Keystone Oil Co.

San Francisco, Cal.—On April 10 will be held the annual meeting of the stockholders of the South San Francisco Railroad and Power Co., at the Northeast corner of Oak and Broderick Streets.

Los Angeles, Cal.—Governor Gillett has signed the bill, introduced by Assemblyman Phil A. Stanton of this place, which is an enabling act to permit Los Angeles to issue bonds for the construction of the Owens River municipal system. The bill provides that bonds may be issued serially so that they may be sold in amounts of $5,000,000 each. Another bill provides that the Board of Public Works in carrying out the construction work may either let contracts for certain portions of it or go ahead and do the work.

Los Angeles, Cal.—Senator Geo. S. Nixon, of Nevada, H. G. Hayes, of Goldfield, and Geo. Wingfield, of Goldfield, constitute the purchasers of the People's Gas Company. They have placed orders in Pittsburg and other steel centers for immense shipments of steel mains, and are planning to increase the capacity of the plant as rapidly as the material can be obtained. Attorney W. M. Goodwin is the local representative of the purchasers of the Lowe Gas Co.

Newport, Cal.—Horace Slater has been in New York raising subscriptions for the installation of a gas plant, estimated to cost $22,000. Of this amount $11,000 is to be raised by subscription and the remainder will be taken by Mr. Slater, R. J. Dunn and C. A. Watson, of Redlands. The company is to be incorporated with a capital stock of $75,000, $25,000 of which is to be paid up.

San Francisco, Cal.—The San Francisco Coke and Gas Co. will hereafter be known as tthe Metropolitan Light and Power Co. With the change of name the concern has increased its bonded indebtedness from $2,500,000 to $7,500,000. At a meeting of the stockholders, held last week, the directors of the company were authorized to make the increase. President Leopold Michels has said that the increase was for the purpose of allowing an extension of the company's mains, adding to the gas plant, and installing a plant to manufacture and furnish electricity throughout San Francisco.

Redding, Cal.—An action has been brought by nineteen of the farmers living along Old Cow Creek to prevent the Northern Light and Power Co. from using the water of the creek for power purposes. The defendants claim riparian ownership of the stream. They desire to use 2,700 inches of water, which, it is alleged, are more than the stream affords in the dry season. It is also alleged that the defendants desire to divert the course of the stream, causing it to leave its present channel, which would result in the alfalfa and grain lands bordering the creek becoming unproductive. It is therefore prayed by the plaintiffs that an injunction rest against the Northern Light and Power Co.

TRANSPORTATION.

San Diego, Cal.—The franchise for a railroad on B Street, asked for by E. Bartlett Webster, was recommended favorably by the Street Committee of the City Council at a meeting of that body a week ago.

Redlands, Cal.—The San Bernardino Traction Company expects to extend its line now branching off the Highland line and leading up to the Base Line road, up into the grounds of the Southern California State Hospital at Patton.

Las Vegas, N. M.—It is said that the proposition to extend the electric railway system here to the town of Mora has been taken up again and is likely to be put through. The project was believed to have been killed by the failure of the towns to unite when it was first exploited.

Los Angeles, Cal.—Bids have been advertised for by the Board of Supervisors for a franchise for an electric railroad upon certain highways in the county. Beginning at the intersection of Indiana and Stephenson Avenues adjoining the east boundary of the city, the road is to run along Indiana Avenue to the intersection of Fifth Avenue.

Sonora, Cal.—The County Supervisors received last week bids for the franchise for an electric railway from the Stanislaus County line across the mountains, via Sonora Pass into Mono County, with numerous branches throughout this country, the same to be built over the public roads. A. H. Kleinecke, who applied for the franchise, opened negotiations by putting in his bid for $100. Chas. H. Segerstrom raised the bid to $150. Kleinecke bid $375, and was awarded the franchise.

Kennett, Cal.—As soon as the rains cease grading will begin for the extension of the Hoit & Gregg electric road from the upper terminus at the lime kiln to the Golinsky Mine. The present road is about two miles long, and is used to convey limestone ore from the quarry to this place, where is is consumed in the smelter and also shipped to different points on the Coast. The road is now transporting about 300 tons daily, but contracts recently closed will call for an increase to 500 tons.

Berkeley, Cal.—At a special meeting of the Town Trustees last week the Key Route was granted the privilege of laying double tracks inside the town limits on Claremont Avenue. The property owners of the district asked that the Trustees grant a franchise for a single track only, maintaining that a double track would ruin the street for business purposes. In overruling the property owners the City Fathers obtained a concession from the company in the shape of a promise to establish a station on the avenue within the city limits. The new line extends on Claremont Avenue from Fifty-fourth Street, Oakland, to the Claremont Hotel.

WATERWORKS.

Tucson, Ariz.—Bonds have been voted for improvements to the water system and fire department. The sum of $25,000 is to be devoted to the water department, providing Congress gives permission.

Goldfield, Nev.—S. S. Johnson has just returned from a trip to Skiddoo, where he reports very promising prospects. He states that twenty-four miles of pipe are being put in to bring water from the Telescope Mountains to the town.

Madera, Cal.—F. W. Krogh, of the Madera Water Company, states that the plant will soon be improved. An elec-

tric pump with double the capacity of the present pumps is to be installed. The mains will be taken up and larger pipes laid. The system will be extended and made more complete.

Phoenix, Ariz.—A bill authorizing the purchase of the plant of the Phoenix Water Company by the city has been passed, and the question will be put to the voters at the next municipal election. Bonds have already been voted for the construction of a new system, but it is believed that the citizens will prefer to acquire the old plant.

Los Angeles, Cal.—The Ross Oscillating Pump Company, incorporated with a capital of $1,000,000, will soon begin operations. The factory is to manufacture a pump so constructed that the amount of liquid to be moved is governed by the speed at which the pump is run. It can be operated with any kind of power. Andrew J. Ross is president and general manager.

Long Beach, Cal.—Improvements in the water system, to cost approximately $25,000, are to be made by the directors for the Long Beach Water Company within the next few months. Additional machinery will be installed and that now in place will be remodeled. The greater part of the improvements will be at the wells and the pumping plant. A reservoir on the northwest side of Signal Hill will be built with 10,000,000 capacity. Extensive improvements in the piping system will also be made.

Santa Cruz, Cal.—The new Casino and Cottage City Fire System will be connected to the city waterworks by a six-inch main. For reserve supply a four-inch pipe from the Hihn System is to be ready for immediate connection. Attachment is made with the pumping system which is to supply the baths. These pumps are to be located in the new power house, in a specially-constructed fireproof room. From there will extend a sixteen-inch main to the bay.

Berkeley, Cal.—An independent water system is to be installed for the new Claremont Heights tract and the Garber property, Claremont Hotel on the east and the grounds of the State institution for the Deaf and Blind on the south and west. R. R. Paterson, of the Paterson-Smith Company, which is handling the tract, and R. Hughes, consulting engineer of the People's Water Company, inspected the tract and the surrounding property for the purpose of selecting a site for a reservoir. It has not been determined where the water will be secured, whether by tunnels or pipe lines.

Oakland, Cal.—William M. Hatfield has sworn to a complaint in the Superior Court to obtain $5,000 damages from the People's Water Company, successor to the Contra Costa Water Company, and will ask the court to declare the franchise of the corporation forfeited to the municipal corporation of Oakland. It is held that the action is based on the same law and similar condition of affairs that obtained in San Francisco when the franchise of the Spring Valley Water Company was declared to be forfeited. In other words, it is charged that the People's Water Company is collecting rates from the people of Oakland without the warrant of law, the contention of Hatfield being that the rates now charged in Oakland are not authorized by ordinance.

Sacramento, Cal.—As soon as possible steps will be taken to provide a filtration plant for the city water supply that will be capable of delivering 20,000 gallons of pure water every twenty-four hours. To obtain such a plant the City Trustees have authorized City Surveyor Randle to advertise for plans giving the first cost of such a plant by any known method, the cost of operation and maintenance, and the method to be followed: Several propositions looking to the installation of such a plant are in the hands of the Trustees, and as soon as all the plans are in, after the advertising, they will all be considered and the cheapest one adopted. One plan proposed is a series of settling tanks and the use of coagulants, another is a filtration through sand and charcoal, while a third is the settling of the water by running an electric current through it.

ILLUMINATION.

Long Beach, Cal.—A large flow of natural gas has been opened up at the asbestos factory, west of town, and it is thought there will be enough to heat and light the factory.

Pasadena, Cal.—Action in the matter of preventing the city from installing a municipal electric lighting plant has been postponed until April 8. The Edison Electric Company has brought about the litigation.

San Rafael, Cal.—The San Rafael Gas and Electric Company is figuring on running gas mains to San Anselmo, Ross Valley, Kentfield, Larkspur, Corte Madera, Sausalito and Mill Valley. To start the ball rolling the company has let the contract for the erection of a 1,000,000-foot gas holder, to be erected in this city.

Los Angeles, Cal.—An ordinance has been adopted by the City Council declaring intention to order the necessary appliances to be installed for lighting with electricity Ninth Street, between Main and Mill Streets. Ornamental cast-iron lighting posts will be erected at intervals of 110 feet on each side of the street.

San Jacinto, Cal.—The first carload of machinery for the Heret-San Jacinto Gas Company has arrived, and the work of building the plant will go forward at once. T. H. Hess is manager of the works, and is making every effort to expedite the completion of the construction.

Olympia, Wash.—A franchise has been granted to W. S. Dole and associates, of Portland, permitting him to construct a gas plant here for heating, power and light. It is stipulated that the site must be purchased by June 1, 1907, and the plant be in operation by May 1, 1908.

Santa Monica, Cal.—The Los Angeles-Pacific Company has agreed to furnish free electrical energy for arc lamps to be installed along Ocean Avenue, between Montana and Colorado Streets. The company further offers to install, without cost to the city, lamp brackets similar in design to those now in use. The matter will come up before the Trustees at their next meeting.

OIL.

Coalinga, Cal.—Superintendent S. A. Gibeson, of the Associated Oil Company, states that his company will soon install a pumping plant on its property on either section 8 or section 36, and that it will probably move Station 1 to the new location.

San Luis Obispo, Cal.—John W. Baresberg, one of the pioneer oil men of this city, and A. J. Redgan have gone to purchase rigs and the necessary machinery to commence operations of the North Star and the San Luis Obispo Mutual oil companies.

San Luis Obispo, Cal.—Outside of San Luis Obispo and towns in the southern part of the county, Cambria has been the first town in the county to organize an oil company to make arrangements to commence development. Messrs. Webster, Brooks and Nelson have secured a twenty-year lease on the 600-acre ranch owned by Mrs. H. Winteroll. An oil company will be organized and the oil developed.

Los Angeles, Cal.—C. L. Danly, sales agent for the Fulton Oil Company, has notified the Board of Supervisors that he withdraws his offer to furnish the county oil from the Sunset field at twenty-five cents a barrel, free on board, Maricopa. He gives as his reason the inability to secure cars for delivery. It is said that th re is more back of this than the simple reason given for withdrawing the offer, and that a combination among oil men may have had its influence in withdrawing the twenty-five-cent quotation.

ELECTRIC RAILWAYS.

Portland, Ore.—Council granted a franchise to the Portland & Mount Hood Railway Co.

Everett, Wash.—A. E. Sander has just let a contract for an additional five miles of road.

Georgetown, Wash.—The Seattle Electric Company has petitioned Council for a franchise along Bateman Street and across the new Duwamish River bridge to Oxbow.

Puyallup, Wash.—The Wescott Tracklaying Company will oegin work at once on the Pacific Traction Company's new American Lake line.

Vancouver, B. C.—The Canadian Pacific Railroad surveyors are surveying for an electric line between this place and Chilliwack.

Columbia, Wash.—Council granted a franchise to Seattle Electric Company for right-of-way over several streets. The line is to be an extension of the Rainier Heights line.

Spokane, Wash.—The Washington Water Power Company is building a double-track line to connect its Maple Street line and Pacific Avenue line on Maple Street.

Helena, Mont.—The Helena & Butte Electric Railway Company has been incorporated with a capital of $500,000. A. W. Varharen, engineer, will commence the preliminary survey at once.

Spokane, Wash.—Engineers of the Spokane & Inland Empire Ry. Co. will make a preliminary survey of the branch line to Rockford and through the Rock Creek Valley into the Coeur d'Alene reservation.

Astoria, Ore.—Council granted a thirty-year franchise to E. B. McFarland for a street railway leading from Commercial Street to the county bridge at Young's Bay where it is to connect with a railway running to Warrenton and New Astoria.

Lewiston, Ida.—G. W. Thompson, president of the Lewiston & Southeastern, states that work will soon be commenced on the electric line and the installation of the power plant. The work will be done by the Schofield Company, of Philadelphia.

Medford, Ore.—Messrs. Blakely & Welch, of the Sterling Mining Company, have applied to council for a franchise for an electric railway to be built from this place to Jacksonville. They also purpose to take over the city light plant and water works systems.

Seattle.—The Seattle Electric Company was granted a franchise on the following streets: Taylor Avenue, Third Avenue south, Nineteenth Avenue, parts of Yesler Way, Prefontaine Place, Thirty-first Avenue, Ewing Street, and on parts of Summit Avenue.

Hamilton, Mont.—The Missoula-Bitter Root Traction Company was organized here by J. L. Humbe, Corvallis; E. O. Lewis, Stevensville; C. M. Allen, Lo Lo; P. J. Shannon, Hamilton, and P. M. Reilly, Missoula. The road will be forty-seven miles long and cost $750,000.

Spokane, Wash.—F. A. Blackwell has begun the construction of a railroad to run from the junction with the Spokane-International at or near Rathdrum, Ida., to Spirit Lake; thence to Newport and up the Pend O'Reille River. The road will be 70 miles in length and cost $2,000,000.

TRANSMISSION.

Jalisco, Mex.—Plans for the hydro-electric plant to be erected by Carlos Romero have been modified. He will use the waters of the Jora River, and will begin work on the plan within a short time.

Los Angeles, Cal.—Bids are advertised for for a tangential water wheel for equipping one hydro-electric generating plant of 125 kilowatts capacity, five miles of 15,000-volt transmission line and step-up and step-down transformers by the City Board of Public Works.

Napa, Cal.—An application has been made to the Board of Supervisors by Harry Brown for a franchise for forty-five years to erect and maintain along the public roads of this county, poles and wires for transmitting current for heat, power and lighting.

Weaverville, Cal.—H. L. Jackman, general manager of the North Mountain Power Company, has been spending a few days in this town. It is reported that his company intends to put in a power plant at Big Flat, about seven miles below North Fork, and will build a 70-foot dam in the Trinity River, which will be used for generating power.

Red Bluff, Cal.—R. P. Stice has filed on 10,000 inches of water in Mill Creek, to be diverted about the center of Section 1 at a place known as Squire's Marsh. M. O. Ballard, who is connected with the Pacific Power Company, filed on 20,000 inches to be diverted near the Avery foot bridge. Both filings were made for the purpose of securing power to produce electricity.

Redding, Cal.—A ten-year contract has been closed between the Trinity Copper Company, otherwise known as the Tom Lawson corporation, and the Northern California Power Company, for electric power to develop the Shasta King Mine. The Trinity Copper Company has provided a 200-horsepower motor at the mine for immediate use. The Northern California Power Company is installing a 2,000-horsepower plant for the use of the Mammoth Mine; a 1,200-horsepower plant at Herault for an iron smelter. An electric plant will be supplied for the Crown Deep Mine.

Nevada City, Cal.—When the weather clears 150 men and 50 horses will go to work on the big power plant on Deer Creek, above this city, in an endeavor to hurry it to completion as rapidly as possible. Practically all the machinery necessary was hauled to the place before the winter's snows set in. The plant is being constructed by the California Gas and Electric Company. It will not be until Autumn that the work will be completed. There are pipe lines to be built, reservoirs to construct, and a myriad of incidental labors to perform. The company will find use for its power in the operation of the Midland road.

WATER POWER.

Washington Water Power Company—Stockholders at a meeting in Spokane voted to increase the capital stock from $5,000,000 to $10,000,000, and it is announced by Henry M. Richards, president, that the money will be expended in betterment of the electric railway system and the extension of several lines. The directors were re-elected as follows: William A. White, George H. Southard and Frank Lyman, of New York; H. M. Richards, D. L. Huntington, J. D. Sherwood, Thomas G. Thomson, J. P. M. Richards, A. B. Campbell, J. N. Glover and Huber Rasher, of Spokane. The officers of the company re-elected for the year are: President, Henry M. Richards; first vice president, A. B. Campbell; second vice president and general manager, D. L. Huntington; treasurer, H. E. Perks; secretary, H. L. Bleeker. The corporation has 72.5 miles of railroad, 54.5 miles of which is in Spokane. Its power transmission lines reach 225 miles, the longest being to the Coeur d'Alene mining camps, 110 miles.

POWER AND LIGHT PLANTS.

Everett, Wash.—The Seattle-Tacoma Power Co. is planning to parallel its lines into Everett from Snoqualmie Falls.

Battleford, Sask.—Bids will be received until April 15th by R. C. Lourie, Clerk, for installing an electric lighting system.

Albany, Ore.—The Samtam Electric Company is arranging for the construction of seven power canals along the North Samtam River.

Indian Head, Sask.—The city will spend $25,000 this year in extensions to the electric lighting plant. T. E. Donnelley, mayor.

Missoula, Mont.—A new 4,000 H. P. water power plant is now being constructed by the Missoula Light and Water Company. A. H. Wethey, manager.

Elma, Wash.—The Elma Light & Power Company has filed notices on what is known as the Cloquallum Creek water power.

Strathcona, Alta.—Council has granted a franchise to the International Heating & Lighting Company to operate a lighting plant.

Victoria, B. C.—Sealed bids will be received by W. W. Northcott until April 8th for the erection of an electric transmission line between this city and Beaver Lake.

Grand Forks, B. C.—The West Kootenai Power & Light Company is considering the extension of its high-tension hydro-electrical lines from the Boundary into the Similkameen district.

Portland, Ore.—The Pacific Light & Power Company, capital $50,000, has been incorporated by C. P. Houston, Junction City; D. A. Houston, Oregon City, and Alexander Sweek, of this city.

Astoria, Ore.—The Astoria Electric Company has awarded contract to W. S. Dole & Company, Portland, for the construction of its new gas plant here, to cost $12,000. C. A. Coolidge, superintendent.

Wallace, Ida.—G. Scott Anderson is at the head of a corporation which will erect a large power plant on Big Creek. The company will be incorporated for $300,000 under the name of the Inland Power Company.

Myrtle Point, Ore.—The Coquille Valley Power Company has been incorporated by J. R. Benson and W. W. Doyoe, of this place, D. H. Johnson and J. A. Davenport, of Coquille. The company has secured water rights and will erect a power plant in Coos County.

Hermiston, Ore.—The Western Mutual Electric Company has been incorporated with a capital of $50,000 by Jas. Tee, E. P. Dodd and others, to supply electricty for lighting and power to the territory under the Umatilla government project.

Bremerton, Wash.—Work has been commenced excavating for the foundation of the central power plant. The building will be 92x180 feet, the floor and basement of concrete, the superstructure of steel and brick. The work will be done by the workmen at the yard.

Ely, Nev.—Extensive improvements and enlargement of the system are being planned by the officials of the White

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Pine Telephone Company, which owns the only 'phone system in this portion of Nevada. The lines are to be extended to the new mining camps in this vicinity, and the service generally improved. An expenditure of $50,000 will hardly cover all the proposed work.

Big Timber, Mont.—Extensive improvements and additions are contemplated by the Big Timber Light and Power Company. A Westinghouse generator of 60 K. W. capacity, and a 90 K. W. dynamo will be installed. J. R. Karserman, manager.

TELEPHONES.

Yorktown, Sask.—The city voted to purchase the telephone system and extend it.

Moscow, Ida.—The Interstate Telephone Company will shortly install a new common battery board.

Boise, Ida.—The Independent Telephone Company is extending its system at Nampa, Caldwell, Payette, Weiser and Emmett.

Dayton, Wash.—The Smith Hollow Telephone Company has been organized by John Crawford, Dan Wood, Will Wood, Neils Peterson, John Story and "Doc" Sutton.

Fernie, B. C.—The Crows Nest Pass Electric Light & Power Company is preparing to establish telephone service to Elkmouth and Hosmer.

Harrington, Wash.—The Pacific States Telephone and Telegraph Company has a crew at work stringing a line to Bluestem and thence to Davenport.

Seattle, Wash.—The Independent Telephone Company announces that the Green Lake station will be opened this week. The building will accommodate 1500 instruments.

Gifford, Ida.—A number of farmers' telephone lines are building into Gifford and several more are contemplated. Those under construction are the Riggers-Jacks line from Riggers' mill, the Hamberley-Slocum line from the Hamberley ranch and the Boyer-Bluett line.

Fernie, B. C.—The Revelstoke Trail & Front Lake Telephone Company will build a long-distance line to Elkmouth and Hosmer.

Umatilla, Ore.—The Farmers' Co-operative Telephone Company, capital $5000, has been incorporated by Omer O. Stephens, DeWitt C. Brownell and John W. Duncan.

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Risdon Iron Works
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INCORPORATIONS.

Los Angeles, Cal.—The Telegraph Oil Company has been incorporated with a capital stock of $300,000. Behind the project are H. M. Cowper, O. E. Seller and J. W. Reynolds.

San Luis Obispo, Cal.—Articles of incorporation have been filed by the Tally-Ho Oil Company, which is capitalized at $5,000, shares $1 each. The place of business is Arroyo Grande.

Sacramento, Cal.—The Western Sierras Power Co. has been incorporated here with a capital stock of 10,000 shares, $1,000 each. The full amount has been subscribed by C. C. Bonte, H. Stillman, E. S. Brown, A. L. Shinn and M. J. Dillman.

Santa Ana, Cal.—The Section Two Water Company has been organized and filed articles of incorporation to develop and distribute water. The principal place of business is Anaheim, and the plant and works of the company are to be located on section 2, township 4 N., range 10 W. The capital stock is $4,500. The directors are J. F. Walker, J. M. Blocher, O. S. Auten, W. Voss and F. R. Lagourgue.

Santa Ana, Cal.—With Alfred D. Bowen, builder of the California Ocean Shore Railroad, as president, the Monterey, Fresno and Eastern Railway Co. has been incorporated with a capital stock of $5,000,000, of which $154,000 has already been subscribed to build a shorter line to Goldfield from Southern California and bring both Los Angeles and San Francisco many hours nearer the great mining regions of Nevada. The plans of the company are to run electric trains. The route has not yet been made public, but probably will be south of Yosemite Park and through the Round Valley and Bishop Creek country.

CLASSIFIED LIST OF ADVERTISERS—CONTINUED

Pumps, Steam
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Simplex Electrical Co., The
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The JOURNAL OF ELECTRICITY POWER AND GAS

WITH WHICH IS INCORPORATED
The Engineers', Architects' and Builders' News

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THE

Journal of Electricity, Power and Gas

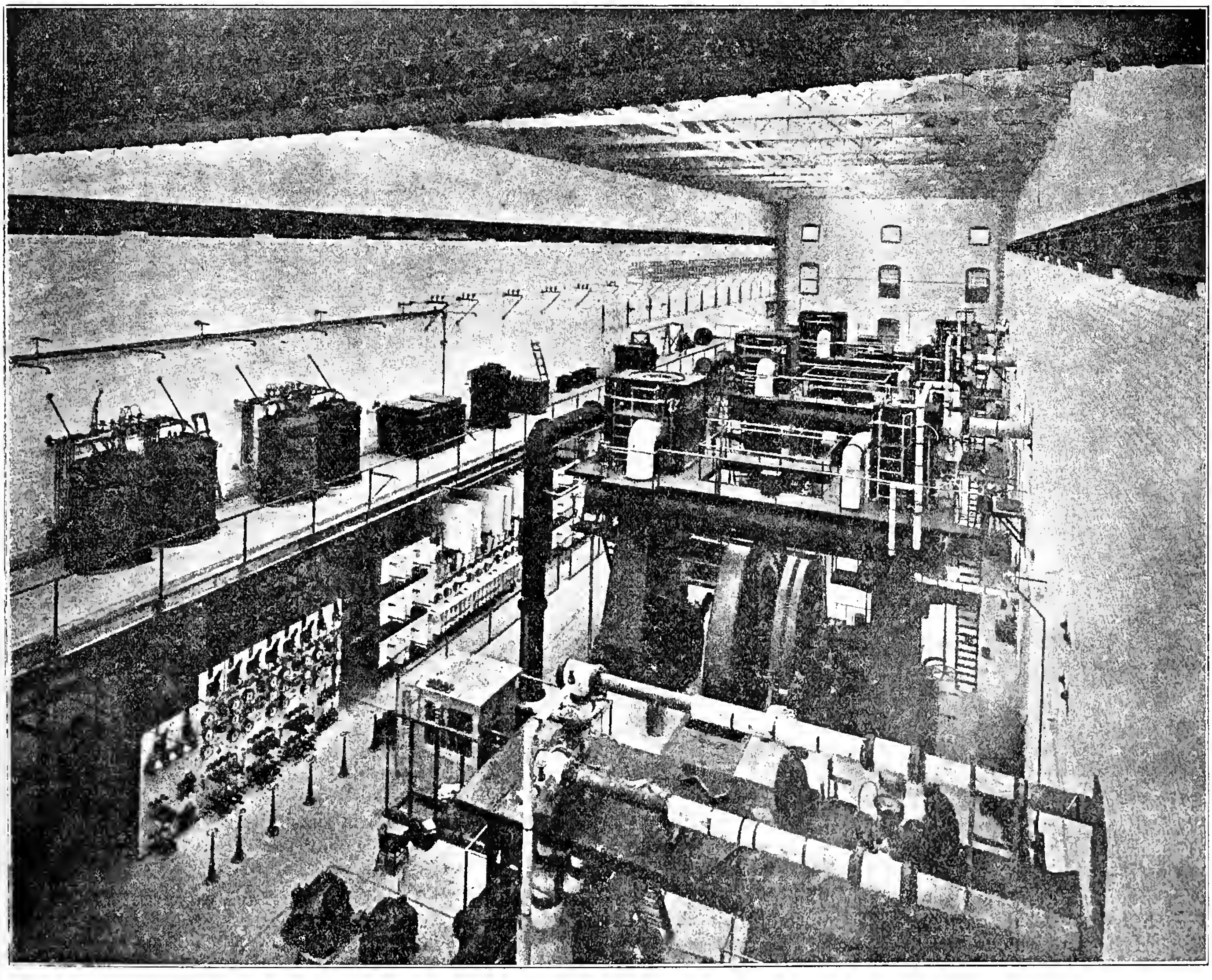
WITH WHICH IS INCORPORATED

The Engineers' Architects' and Builders' News

VOLUME XVIII. SAN FRANCISCO, CAL., APRIL 20, 1907 No. 16

The Recent Fire In Station "A" of the San Francisco Gas and Electric Company.

At about seven o'clock in the evening of Tuesday, April 2nd, an alarm of fire was hurriedly sent in from Station "A" of the San Francisco Gas and Electric Company. A blaze of a threatening character had been discovered on the roof of the south boiler room, and only the timely and effective action of the fire department prevented the loss of a plant valued at from eight to nine million dollars. As it was, the loss will probably not exceed $150,000, though it was feared at first that the damage to the building and machinery would amount to over two million dollars. This station is situated at Twenty-second and Georgia streets, in the Potrero district, and is the most important of the local electric stations in the system supplying San Francisco with electric power.



GENERAL VIEW STATION "A" OF THE SAN FRANCISCO GAS AND ELECTRIC COMPANY

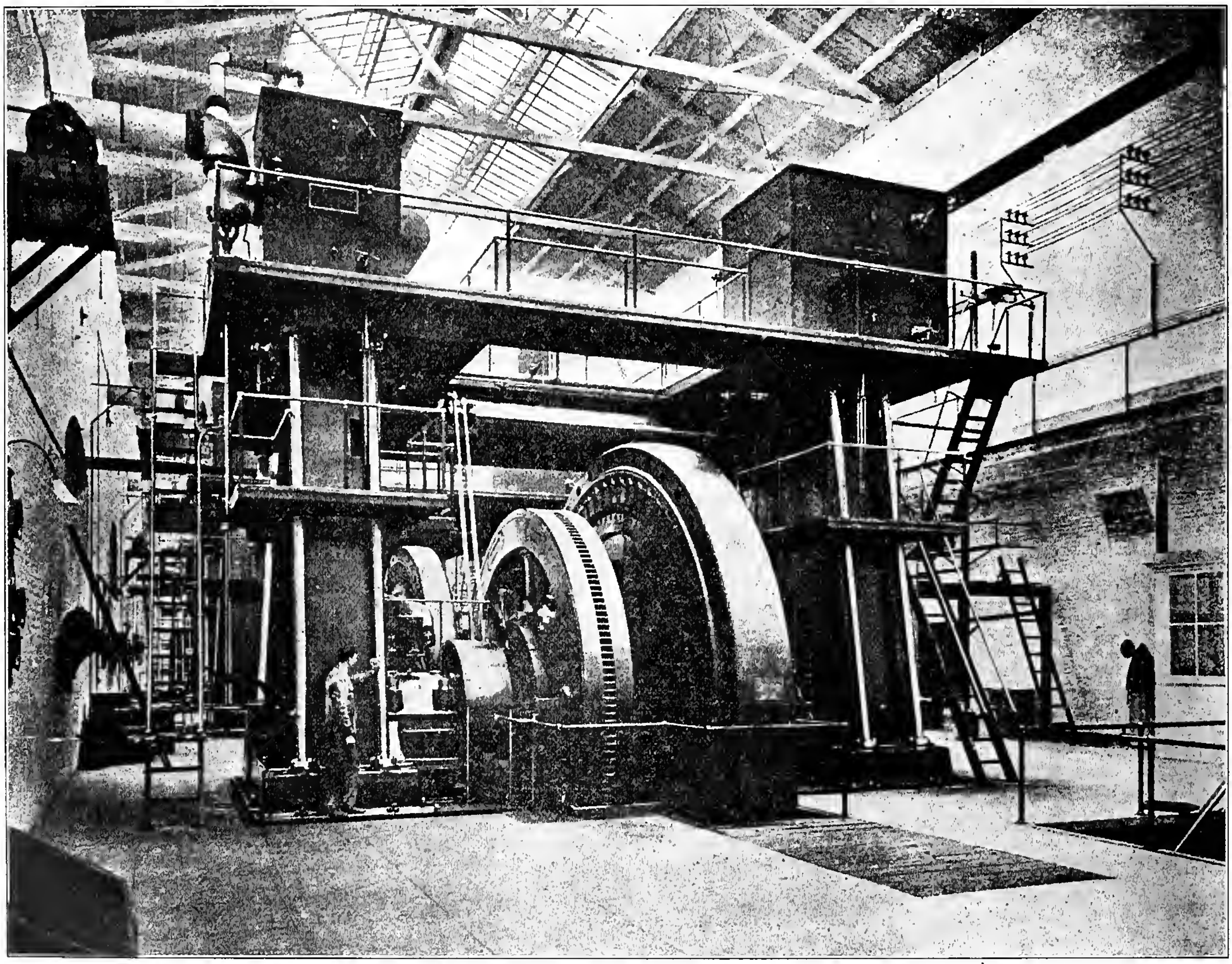
The destruction of this plant would have seriously crippled the electric lighting and power service in San Francisco, as the load is divided between this steam-driven plant and the hydraulic plants in Amador, Butte and Yuba Counties

There are installed in this plant ten direct-connected units supplying the various sub-stations for distribution about 250,000 kilowatt-hours daily.

The building is about 140 feet wide and 433 feet long, and is divided into an engine room and basement running the full length of the building and two boiler rooms. The walls are of brick. The roof was partly of glass and partly of wood covered with slate. It was at first supposed that this wood had become gradually charred by the heat from the smokestack and that the existence of conditions favorable to spontaneous combustion had caused it to burst into flame. This theory is, however, not substantiated by those who were familiar with the condition of the roof before the fire and who examined the unburned portion afterward.

off of their flanges and otherwise damaged the equipment. In the engine room the units designated by numbers from six to ten, which are under the burned portion of the roof, were temporarily put out of service. On most of these the piping and tubes were broken or bent, the gratings and railings were torn away, and various parts were so broken or strained that it has been necessary to dismantle the units to a greater or less degree.

The switchboards, switch room and feeder cables were not injured. The units numbered from one to five and the steam generating equipment in the north boiler room, which form the greater part of the original equipment of the plant, were not damaged, so that at midnight, about five hours after the fire had been discovered and before the firemen had left



ONE OF THE 1,500 KILOWATT MCINTOSH AND SEYMOUR-WESTINGHOUSE UNITS

During December of last year, owing to the great demand for power from this station, the boilers were forced to their utmost capacity and the possibility of fire was then feared. The roof was carefully watched at the time and it was found that the wood work had not been affected in any way. It is probable that the fire was started by sparks thrown out from one of the furnaces. The fire in the north boiler room on the succeeding day probably originated from smoldering wood which had been overlooked by the firemen.

With regard to the damage done the roof of the south, or new, boiler room and about ninety feet of the roof of the engine room were burned away, while other portions were so badly damaged that it will be necessary to replace them. In the fire room the intense heat and the falling timbers destroyed the pipe covering, cracked valve casings, pulled pipes

the building, it was possible to start up two of the units and throw on the usual load, which they could easily handle during the succeeding period of light demand.

As soon as the firemen arrived, it was of course necessary to shut down the plant, but before doing this the greater part of the load was transferred to the transmission lines from the hydraulic plants and to the reserve gas-driven units in the Martin power plant.

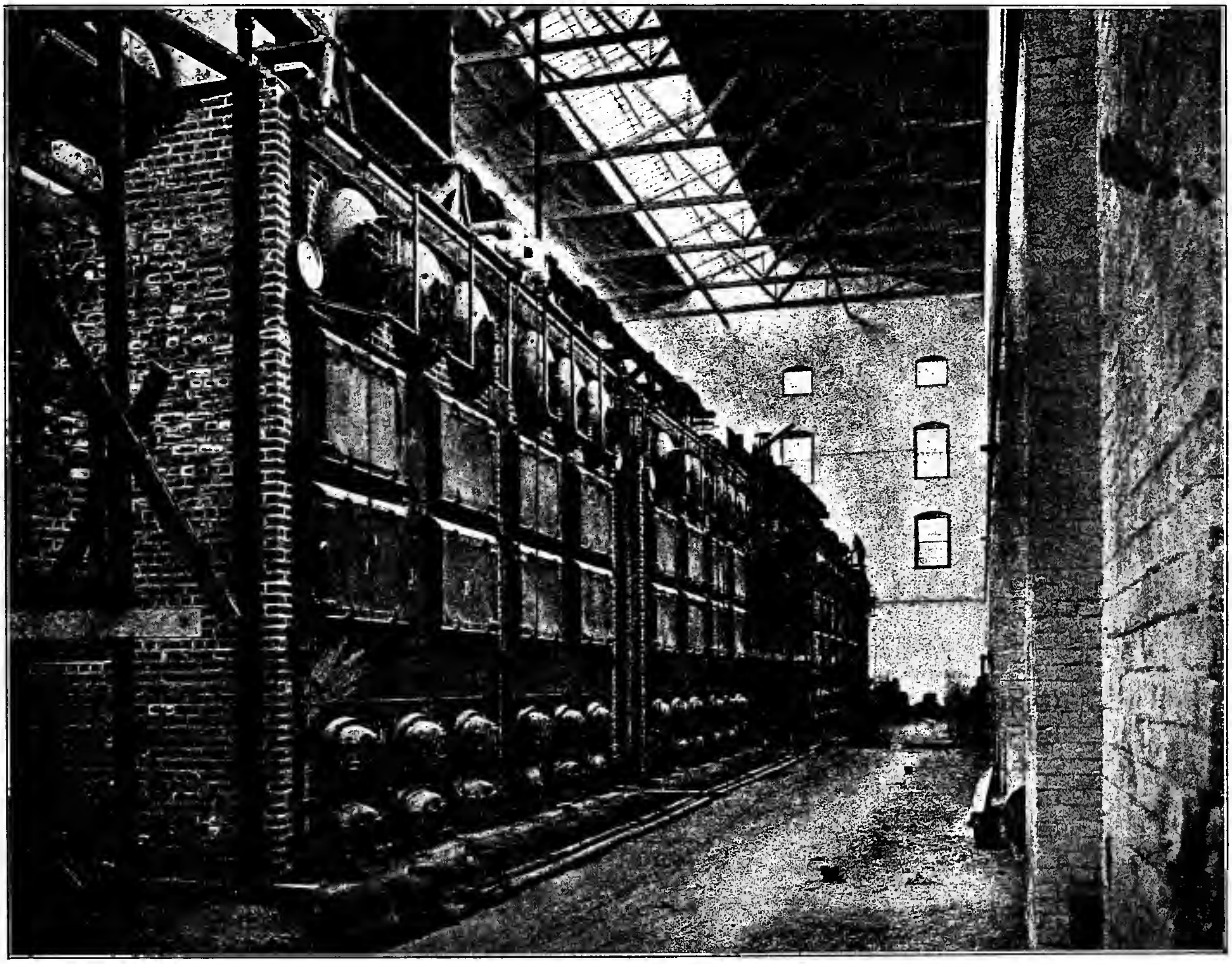
At about 11:30 p. m., at which time the fire was nearly out, the exciter set in the north end of the building was started and a little later one of the engines was started up with atmospheric exhaust. Several of the lighting circuits in the building were connected in as it was deemed advisable to test out for short circuits while the firemen were still in the vicinity. As soon as electric power was available for

operating the motor-driven circulating pumps for the condensers, an additional unit was started up and both engines were run condensing. The load was then gradually thrown on.

While the firemen were carrying on their battle with the flames, messages were hurriedly sent to the operating engineers from other stations of the company, and employees were sent out to gather up a large force of men. As soon as practicable the men were divided into gangs and began the work of clearing away the debris. In a remarkably short space of time the fallen timbers and other wreckage were carried out. Under the direction of the engineers the work of examining and repairing the damaged equipment was undertaken as soon as conditions would permit.

Electric Light and Power Company and was later purchased and its capacity more than doubled by the San Francisco Gas and Electric Company. The older units consist of five McIntosh and Seymour vertical cross-compound engines direct connected to Westinghouse alternators supplying current at 500 volts and having an aggregate capacity of about 7,500 kilowatts. This older equipment was fully described in The Journal for December, 1901. At the time of its installation it was considered one of the most modern plants in America and though practice and operating conditions have changed considerably since then, it compares very favorably in many respects with the installations of the present time.

The new equipment, however, conforms to the most modern practice in the selection of machinery for large power



TRANSVERSE SECTION OF THE PLANT

stations. The new generating units are five in number. The engines are all of the vertical type and are operated by steam at 185 pounds pressure, with a normal superheat of about 125 degrees Fahrenheit. Direct-connected to these are three-phase, revolving field, 60-cycle alternators which supply current at 11,000 volts to underground feeder cables running to the various distributing sub-stations.

All efforts were devoted to getting the plant ready for immediate operation and much of the work done is therefore only of a temporary character. The greater part of the required materials was necessarily taken from the most available sources. Owing to the scarcity of copper gaskets rubber gaskets had to be used instead.

On the following day after the fire, all the districts in San Francisco were receiving their normal amount of power, and on Friday morning, two days later, all the units were in operation but one. The generators in the exposed part of the building are protected from falling mist by large canvas coverings.

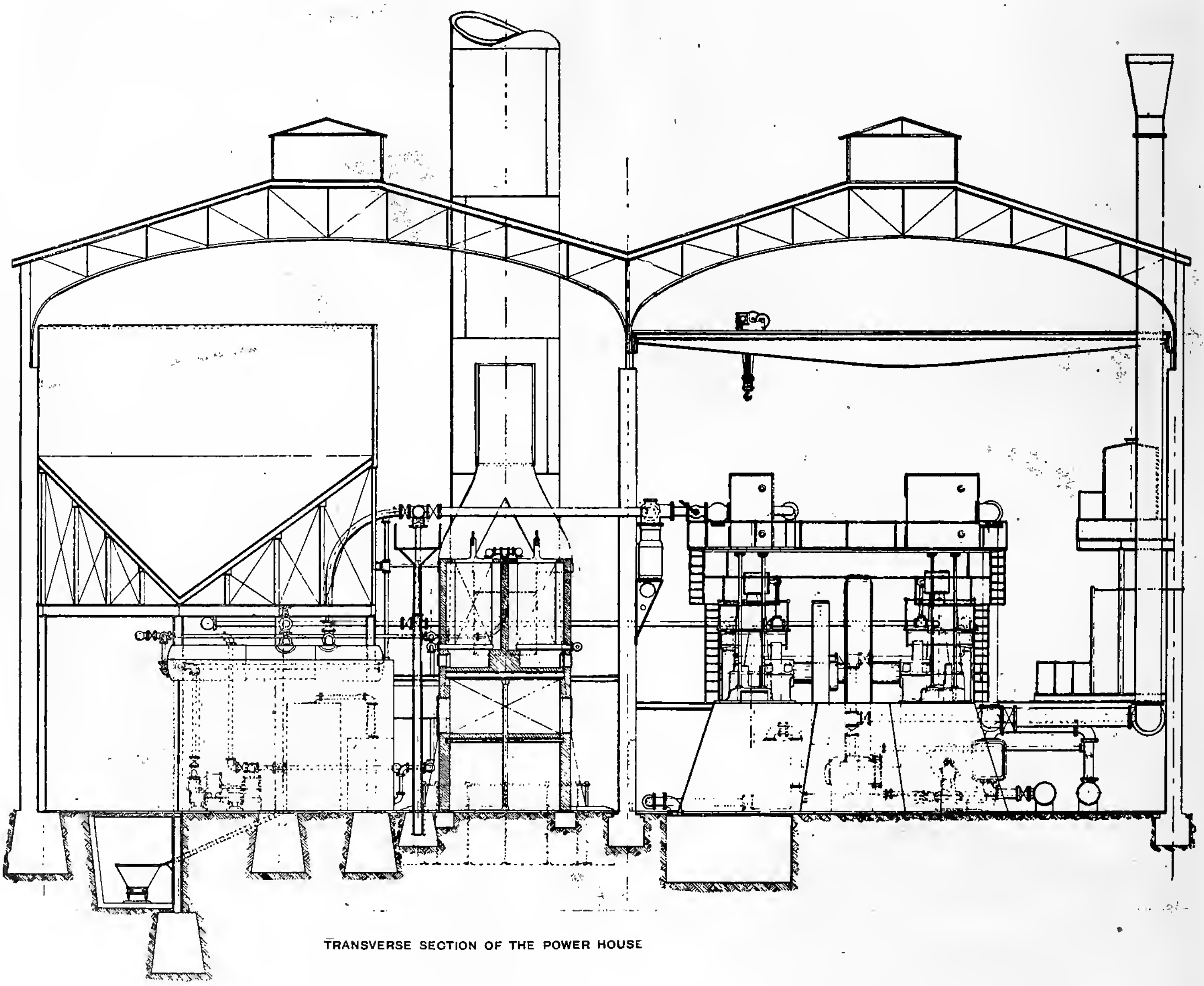
The northern half of Station "A" and most of the equipment installed therein was built in 1901 for the Independent

No. 6 unit consists of a McIntosh and Seymour cross-compound engine of dimensions 28x58x48 inches driving a 1,500 K. W. Westinghouse alternator. The remaining four engines are of the triple expansion type and were built especially for this plant by the Union Iron Works. The engines for units Nos. 7 and 8 are of dimensions 24x36x54x36 inches. The alternators are also 1,500 K. W. machines of the West-

inghouse manufacture. Units Nos. 9 and 10 each have a capacity of 3,500 K. W. The engines are of dimensions 36x66x90x 48 inches. The alternators were built by the General Electric Company.

The Wheeler "Admiralty" surface condensers are used. These ordinarily give a vacuum of about 27 inches of mercury. In connection with the condenser for the McIntosh and Seymour engine an Edwards three-throw air pump driven by a 50 horsepower, three-phase induction motor is used. The air-pumps for the triple-expansion engines are built within the engine frame, the pistons being actuated by a link motion operated from the cross-heads of the high pressure cylinders.

steam at 185 pounds pressure with a superheat of about 125 degrees. The Heine boilers, each of which is rated at 500-horsepower, are set in one battery, the furnace gases passing into a single Heine steel stack 96 inches in diameter and 100 feet high. The Babcock and Wilcox boilers, which have a rated capacity of 780 horsepower each, are set in two batteries of six and three boilers respectively. The furnaces are connected to three 72-inch Babcock and Wilcox steel smokestacks also 100 feet high. The furnaces are oil burning, the Wilgus burner being used with the Heine boilers and the Hunt-Mirk burner with the Babcock and Wilcox boilers.



TRANSVERSE SECTION OF THE POWER HOUSE

The circulating water is supplied from the San Francisco Bay by four Byron Jackson, single-stage, centrifugal pumps located in a pump house situated about 1,500 feet from the plant. Three of these are direct-connected to 100 horsepower, 500-volt, 3-phase induction motors; and the fourth, which is much larger, is driven by a 350-horsepower, 11,000-volt, 3-phase synchronous motor. The smaller pumps have 16-inch suction pipes and the larger pump a 30-inch suction pipe. The four pumps feed into a single 36-inch main. The discharge from the condensers runs back to the Bay by the force of gravity.

The new boiler equipment consists of six Heine and nine Babcock and Wilcox water-tube boilers which generate

The feed water and oil pumps are located in the southwest corner of the new boiler room. There are two tandem, duplex, Snow feed-water pumps 12x19x10x18 inches, and two Snow oil pumps 8x5x10 inches. Goubert heaters and Green economizers are used.

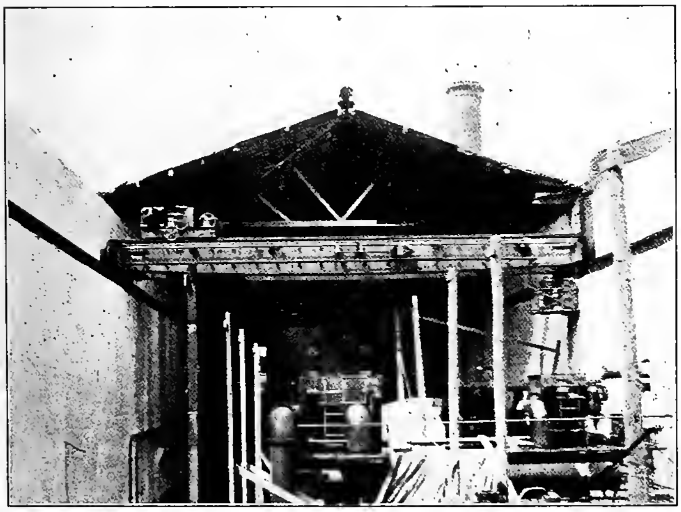
For the storage of fuel oil there are three riveted steel tanks, two of which have a capacity of 25,000 barrels each and the third a capacity of 10,000 barrels. These tanks are located near the water's edge and are filled directly from oil barges.

One of the interesting features of this plant is the lubricating oil system. The apparatus is kept in a special oil room, which occupies half of a small corrugated iron house

built apart from the main building. The oil after passing through the bearings of the engines flows by gravity into a receiver tank placed in the basement below the engine room. From there it is pumped by a Dow 3x2x3 inch pump to a settling tank, which is the middle one of five tanks set in a row. In this tank the oil and accumulated water and foreign matter are allowed to settle until they are well separated. The oil is then drawn off through a strainer into a receiving tank from which it is pumped by another Dow pump to either of the two kettles on the right and left of the settling tank. Live steam is circulated through the iron steam coil in the

THE NEW BOILER ROOM SHOWING THE CONDITION OF THE PIPE COVERING AFTER THE FIRE

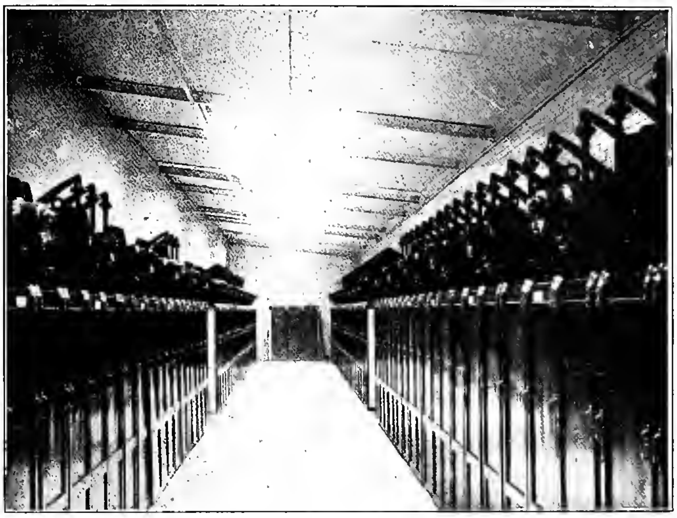
kettle until the separation is practically complete. The oil is allowed to cool and is then drawn off into one of four supply tanks placed on the floor or, if these are full, into the storage single main running to the engine room. Within the tanks a pressure of about sixty pounds is maintained by connection



FIVE-TON ELECTRIC CRANE AND VIEW OF ENGINE ROOM AFTER THE FIRE

tanks on the right and left of the steam kettle. The supply tanks have a capacity of 145 gallons each and feed into a with a steam-driven air compressor, so that the oilers can get their oil from the distributing pipes by merely manipulating a valve or cock.

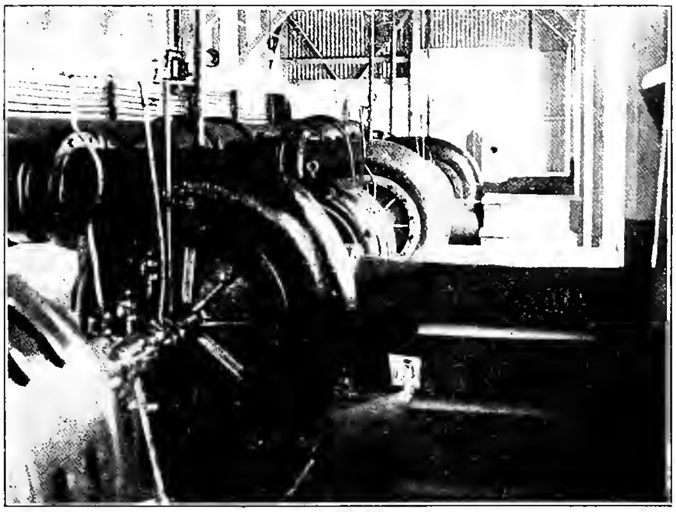
The Shaw electric girder crane shown in the photo-



THE SWITCH ROOM SHOWING THE REMOTE MOTOR-CONTROLLED OIL SWITCHES

graph was in constant use during the repairs to the damaged engines. It has a capacity of 10,000 pounds.

This electric power station is operated entirely for the generation of power. The distribution at the required voltages is accomplished from sub-stations placed in various parts of the city. In the switch room shown in one of the photo-



CENTRIFUGAL PUMPS DRIVEN BY INDUCTION MOTORS. THESE SUPPLY WATER TO THE CONDENSERS

graphs there are thirty-eight general electric, remote motor-control, oil switches connected to the double sets of bus-bars, there being two switches for each of the ten generating units and two for each of the nine feeder cables.

It is intended to avoid the repetition of the recent fire from a similar cause by the construction of a fireproof steel and re-inforced concrete roof.

The Pacific States Telephone and Telegraph Company in name no longer exists. It is the Pacific Telephone and Telegraph Company, according to advices received by the Spokane office. The Pacific States absorbed the Sunset Telephone and Telegraph Company early this year, both corporations being known as the Pacific Telephone and Telegraph Company. The change of name, however, did not apply to the lines in Idaho, for the head office instructed the Idaho offices to continue using the word "States." Now comes word to drop the word "States" and confine to the name Pacific Telephone and Telegraph Company.

MOTORS FOR MACHINES AND TOOLS.*

Substitution of Electric Drive for Steam Drive or Water Drive by Belting and Shafting—Consideration of the Fire Dangers—Advantages of the Use of Electricity in Mills and Workshops.

By Dana Pierce.

The use of electric motors in mills and shops is now so general that there is some difficulty in realizing how few years have passed since electric power was first used for manufacturing purposes. Motor-driven tools and motor-driven machinery of every discription are now common enough, and although a machine shop, a cotton mill or a printing house make less appeal to popular interest than telephones, trolley lines and wireless telegraphy, it is yet true that, in none of its multifarious applications, has electricity brought about more important or more radical changes than in the operation of great and small factories and shops by the sturdy and accommodating electric motor.

It is neither necessary nor appropriate here to discuss in detail all of the advantages of electric drive over belts and shafting. Arguments that were novel once are commonplace now. Ease and economy of power transmission, flexibility both in installation of machines and in their operation, increase of output, resulting from uniform speed or from instantaneous and exactly controllable speed variations, and above all, efficiency, both mechanical and commercial, and other advantages have been investigated thoroughly and have been demonstrated satisfactorily by experience in numerous and widely dissimilar classes of service.

Thirteen years ago the first textile mill was equipped to employ electric drive on a large scale. The development of the art has been so rapid that today, not only in the textile industry, but in almost every other kind of manufacture, electric motors find extensive use in shops both large and small. It may, therefore, be desirable to consider the effect of this great increase in the use of motors upon the fire hazard. It may be well to recall here the oft-repeated fact that electric generators, wiring and motors are simply means of transmitting energy from steam engine or water wheel to loom or lathe or machine tool. The electric system of itself creates nothing. On the physical side, the question, therefore, evolves itself into a consideration of the comparative dangers attending the transmission and control of energy by electrical and other means, and, since energy always transforms itself sooner or later into heat, we have to guard against the development anywhere of an excess of heat which may cause a fire.

The prime mover in every system is either an engine or a water wheel and, if these are housed in the factory building, they present the same hazard, whatever means may be employed for distributing the energy developed by them. But, with electrical distribution of the power, it is not necessary that the prime mover be placed near the machinery it is to drive. Boilers and engines or water wheels need not be either in the main factory building or an extension to it, but may be placed in an entirely separate structure located in the most advantageous place at almost any distance from the factory proper. The power house can then be constructed in a manner to be thoroughly safeguarded, and thus it will cease to be a factor in the fire hazard of the rest of the plant. While considerations of convenience and expense are doubtless the controlling factors in the design of the plant, the possibility of thus isolating the power house from the other buildings is a factor of great importance in considering the fire hazard.

The modern electric generator and its controlling apparatus are now so thoroughly well designed that, when properly installed, their presence in a suitably arranged power house need not add materially to the fire risk of that building, especially as compared with the necessary boilers with their fires and flues. The principal risk in a generator room is probably from the wires, where a large number are brought close together, especially about the switchboard. But, where the wires have a tight, non-combustible cover, as required by the National Electrical Code, and are well insulated and supported by the use of non-combustible materials, this hazard can be reduced to a minimum for normal operating conditions, even with a large group of wires.

The foregoing considerations apply to factories that have their own dynamos. If, however, energy is derived from a source wholly outside of the plant, as a central station, an advantage results from the entire elimination of engines, boilers, coal and their attendant dangers. In a factory operated by electrical energy supplied from a remote station, we have only the hazards incident to the distribution of the power—that is, the wiring systems and the motors.

Without knowing the exact amount of the account to charge up against boilers, flues and overheated bearings, we know that it contains a number of important items, and, therefore, when a mill does away with all of these hazards by the introduction of electricity, with energy supplied from some outside source, the insurance man considers that a right step has been taken and looks to see how much should be charged up in fire losses to the form of energy substituted.

The National Electrical Code sums up in its rules for installation the combined experience of manufacturers, users of electric appliances, insurance bureaus and inspectors and the results of years of experience and observation. While by no means perfect or final, these rules undoubtedly afford the best available standard of present practice, and compliance with their requirements produces an installation as thoroughly safe as is possible at the present state of the art. It is, therefore, possible now to arrange wiring and motors in a manner to insure the minimum risk, and, in general, the larger the equipment the better it is likely to be, because motives of economy and efficiency will, for a large plant, prescribe more careful engineering in the design of the equipment and greater skill on the part of those who supervise its use and maintenance than are employed usually in smaller establishments.

Electric drive will not, of course, remove all of the fire hazard from the power distribution equipment, but it is true that there is no longer good reason for considering the presence of a well-designed and properly installed system of electric drive a serious factor in the fire hazard of a plant, and there is still less justification for the use in such equipments of fittings, apparatus or methods of wiring which experience has shown to be hazardous. A narrow economy in first costs is unwise from the point of view of the owner of the risk and is properly penalized by a resulting increase of insurance rates.

Coming now to comparison of wiring and motors with the old system of shafts and belting, we may note first the possibility of eliminating altogether belt-towers and openings through partitions and floors for belting and shafting. It thus becomes possible to construct buildings with fewer breaks in floors and fire walls. Every reduction of the number and area of openings through floors and partition walls makes it possible to more completely protect each room. The necessary passages and doorways can be protected by fire doors of approved patterns, and fireproof floors retain their full value. Belt boxes are natural traps for dust and rubbish and are not infrequently set on fire by the friction of slack belts against the wooden surfaces.

Wherever shafting is used there is the hazard of heating effect produced by undue friction at bearings or pulleys, a hazard which may be minimized but not entirely eliminated. The following paragraphs quoted from an article by S. B. Perry in the quarterly bulletin of the National Fire Protection Association, July, 1906, express clearly the possible dangers.

"Among the many sources of excessive friction attending the use of shafting lines and belts for power transmission are journals and bearings out of alignment, or out of round, due to improper fitting or materials, poor lubrication,

*From "Insurance Engineering."

loose bushings in wood pulleys, pulleys overloaded or out of balance, belts frayed or in contact with woodwork, belts slipping on wood rims, etc.

"With respect to the pulley, three kinds are common—steel or iron, wood, and steel spider with wood rim. In the iron pulley the hazard of heating is absent, except in that type known as the 'loose pulley,' which is used in belt shifting, and is practically a journal box or bearing. This is liable to heat, if not properly lubricated. The most common form of wood pulley is that termed 'wood split pulley.'

"The usual trouble with this type is liability of looseness at the bushing. The so-called loose pulley should never be made of wood. While overheating from some of the foregoing causes is at times unavoidable, it is nearly always faulty arrangement or conditions which are directly responsible for the resulting fires. Take, for instance, machines belted to a small auxiliary or counter-shaft located on the floor; these are usually boxed in, and they form receptacles for the collection of oily sawdust; or, take lines of shafting run in trenches or low basements, not easily accessible for lubrication and cleaning. Wood pulleys also collect dust, which is seldom cleaned out. These and many others are dangerous conditions promoting fires."

Where each machine in the establishment is driven by its own motor, all shafting may be dispensed with. Where group driving is used, the shafting may be of much smaller diameters, with consequent reduction of the number and the weight of journals and hangers, with their attendant troubles.

An arrangement that has some advantages, is to locate motors and shafting in a fire-resistive basement under the machine room. That necessitates belt openings in the floor, but in a one-story building it is not very objectionable, and, where the machine room is liable to contain quantities of shavings, sawdust or other readily combustible or finely divided materials, it at least removes the motors from the immediate vicinity of the very combustible substances.

It is often well to run the main shop wiring open on ceilings and carry the branch lines to motors from the mains to starting boxes in steel conduit.

The substitution of motors for mechanical drive may be said to transfer the points of possible trouble from the belts and shafting to the wiring circuits, motors and control devices. The latter have, at least, this advantage: They usually are, when in use, under immediate observation, and failure or defect is thus less liable to escape prompt attention.

The electrical hazard may be measured by the ignorance of the person in charge of the equipment, and is also, as suggested in the foregoing, generally in inverse ratio to the size of the equipment. Installations of from twenty-five to one hundred motors are usually under the charge of a competent man, whose duty is to look after the equipment and maintain it in proper working condition. In such a mill the chances of misuse of electrical apparatus by ignorant or careless operatives are greatly lessened.

The single, small motor, tucked away in a dusty corner of a small shop, supplied by wires put in as cheaply as possible and operated by men who have absolutely no idea of the nature of the machine, is the motor which presents the greatest fire hazard, and should be viewed with the least favor by the insurance inspector or agent.

A similar distinction may be drawn between different industries. It is noteworthy that those which have utilized electric power for the greatest length of time seem to show fewer proportionate fire losses from electricity than those into which it has been introduced more recently. The printing business is an example in point. Not only do small job printers very generally have motor driven presses, but the largest presses are now made with motors attached, and the present-day press operator has perforce become as familiar with the functions of his motor and its control as with the details of his press, and it is a most encouraging sign from the insurance viewpoint.

Largely, in proportion as operatives become familiar with electric machinery, its peculiar features and inherent dangers, will the hazard from the ever extending use of motors be reduced.

In machine shops, even with the most automatic machine tools, the operator becomes to some extent an expert and learns quickly to appreciate the limitations of his motor and realizes that missue of its entails delay and consequent lessening of production. If he insists on starting his motor too quickly, he at once sees the effect in the drill or lathe and governs himself accordingly.

Flour mills and small elevators present special hazards when electrically operated, not only from the peculiar dangers of such risks, but quite as much from the comparatively unskilled laborers employed in them.

Bearings and pulleys in elevators and flour mills are exposed to exceptionally bad conditions as to collection of dust and oil, and are often placed where inspection and supervision are very difficult. Any arrangement tending to reduce the amount of necessary shafting would appear, therefore, to present special advantages in these risks. However, when the machinery is driven by individual motors, we have, in the case of direct current motors, the hazard of sparking commutators. The possibility of trouble from overheated wiring, starting boxes, switches, fuses and other electrical paraphernalia is also considerable, and it goes far to offset the possible gains from electrical power transmission in the risks.

Cotton mills also present peculiar problems, but these have been solved very largely in the years since electricity was first introduced into them. In this field alternating current motors have been notably successful, and they are peculiarly suitable, as they do not require commutators, with resulting possibility of sparking at brushes.

Woodworking shops offer special attractions for motor driving, because many of the machines are in use for short intervals only. The hazards are obvious, but they may easily be reduced by proper choice of equipment, although the average operative is probably less likely to become familiar with the details of the electric appliances. The pattern shops, connected frequently with foundries, are of course a common type of woodworking shop.

An interesting recent installation of electric drive is in the plant of the West Virginia Pulp and Paper Company, at Piedmont, West Virginia. Electric power is now used exclusively, and it replaces about thirty-five steam engines of from seventy-five to one hundred horse power that were operated independently in the plant. All of the engines, with the piping and boiler equipment, were torn out. Power is furnished from a central station, located centrally in the plant and built of concrete and steel. The provision is for 7,200-boiler horse power. The motor equipment consists of sixty-five induction motors, utilizing belt drive and direct drive and operating on a three-phase, 440-volt system of distribution. Additional equipment of induction motors, aggregating 755 horse power, has been ordered for use in an addition to the plant for making coated paper.

Packing houses are among the establishments in which it is difficult to maintain electrical wiring and apparatus in good order, because of the presence of water on floors and ceilings, the excessive heat in many parts of the establishments and the injurious effects of brine and other corrosive agents. It follows, therefore, that special pains must be taken in the electrical equipment of a packing house, and frequent expert inspection is required to maintain the apparatus in proper condition.

In steel mills the electric motor has found lately one of its most important fields of usefulness, units of very large size being employed for the operation of individual machines, such as rolls, presses and shears, and for the operation of conveying machinery. These are very often equipped with

elaborate remote control, or semi-automatic apparatus, requiring for the actual operation merely the pressing of a button by an unskilled laborer. The size and complexity of the electrical equipment, with the absolute necessity of maintenance in good operating condition, require usually the presence of an expert electrical engineer, whose services tend to reduce the probability of disaster from failure of the electrical equipment.

It may be stated in a general way that electrical apparatus may be especially hazardous from either of two quite extreme conditions. The first is the simple, cheap installation of one or two small motors, the apparent simplicity of which begets in the minds of its owners an indifference to the possible dangers. The second is an elaborate and expensive equipment, entailing many wiring circuits and utilizing to the utmost the advantages of automatic devices and remote control apparatus.

As appliances become automatic, or removed from immediate observation and control by operators, there is a disposition to rely upon the system to do the work under any and all conditions. Unskilled laborers will persist in endeavors to "make it work" under conditions which would clearly indicate trouble to a skilled electrical man, or would be evident at once in a simpler system.

In connection with this it is in order to direct attention to the presence, in electrically operated plants, of freight elevators worked by motors, often of large horse power and controlled from the car. The elevators get only scant indulgence from the men who are called upon to run them, and they may be a source of very real danger unless well supervised and safeguarded.

There are numerous classes of risks that call for special consideration from the underwriters in the event of their being electrically equipped. Many manufacturing processes involve the use of naphtha or other volatile and explosive liquids, or necessitate the storage of extra dangerous substances. The best equipment, provided electric power is to be used extensively in the risks, can be determined only by good engineering skill, supplemented by a thorough knowledge of the special hazards involved and the lessons of experience. Enclosed direct current motors, or motors of the induction type, are safest. Switches and cutouts, or fuses, should be placed in self-inclosing, fireproof cabinets, easily accessible. Electric lighting is adopted often as a consequence of the adoption of electric power transmission, introducing the special problems incident thereto, most of which are solved sufficiently in the National Code.

WIRELESS TELEGRAPHY ON THE PACIFIC COAST.

The operator in charge at Point Loma station reports having read on the evening of March 16th a message of some length, which was transmitted from the station at the Pensacola Navy Yard, Fla., and that he heard but could not read what was probably a reply from the Connecticut. This has been verified as to the Pensacola message, distance 1,768 miles, all overland, and as to hearing the Connecticut, which was at the time 100 miles to the north of Cuba.

The sailing of the Milwaukee, fitted with Shoemaker apparatus, was made the occasion of testing out the northern stations, the results of which were very gratifying, and are as follows:

Maximum distance intelligible communication was carried—distance in sea miles:

Station—	Distance.
North Head	1,130
Mare Island	760
Farallon Islands	750
Point Arguello	425
Point Loma	540
U. S. S. Charleston	600

These distances do not give the greatest range of communication possible, except in the case of North Head, as there was interruption of the test when the Milwaukee had picked up the flagship, and transmission of regular business.

The station at Table Bluff has not yet sufficient power to have taken any great part in this test, but the operator in charge reports hearing the Milwaukee distinctly until 1 a. m. of March 16th, the distance being 862 miles, and static very strong.

The contractor who has built all the naval wireless telegraph stations on the Pacific Coast, W. N. Concanon, has resumed work on the station at Cape Blanco, Ore., which was interrupted by the unusually bad weather of the past winter. It is expected that this station will be working within a month. This will complete the chain of naval stations along the Pacific Coast from Point Loma to Tatoosh Island, off Cape Flattery.

An expedition is preparing for the installation this coming summer of naval stations at Sitka and Valdez, Alaska. These stations will have greater power than any previously installed on the coast.

The success of the naval stations has been greater than was anticipated. The range of communication has increased as the skill of the operators, resulting from practice, has increased. All operators at the Pacific stations are graduates of the electrical school maintained at the navy yard, Mare Island, which has been mentioned in The Journal of Electricity.

The power of the Alaska stations will be derived from gas engines, connected by silent chain drive to alternating current dynamos.

It has been decided to do away with storage batteries at wireless stations and secure reserve power by installing duplicate gas engines, except where a local source of power can be secured, as at Table Bluff, near Eureka. Here the Fortuna Lighting Company has contracted to supply current.

The naval stations along the Pacific Coast are: Point Loma, Point Arguello, Mare Island, Yerba Buena, Farallon Islands, Table Bluff, North Head (mouth of Columbia River), Tatoosh Island and Puget Sound Navy Yard.

Mare Island and Puget Sound are in nightly communication, distance 654 miles.

The Pacific squadron at Magdalena Bay keeps in touch with Washington, through Point Loma and Point Arguello stations and is given press news by the former station nightly. The distance from Point Loma to Magdalena Bay is about 600 miles.

JAPANESE OAK TIES FOR CALIFORNIA.

Japanese oak is now being used for ties in California. It hardly seems credible that hardwood timber is so scarce and the transportation facilities so overtaxed in our Western States that oak ties can be purchased in Japan, and shipped to California to be sold there, duty paid, at a lower price than ties made from local redwood. That this is practicable is evidenced by a recent purchase of 1,500,000 Japanese oak ties for the Southern Pacific Railway and about 50,000 for an extension of the Vallejo, Benicia & Napa Valley electric road near San Francisco. These ties have now been delivered, and at a lower cost to the purchaser than soft redwood ties of smaller The timber is said to be equal to our best white oak.—Electric dimensions could have been purchased in the local market. Railway Review.

NITROGEN FROM AIR AS FERTILIZER.

The Chemical Society of Washington, one of the branches of the National Chemical Society, was addressed recently by Dr. A. Frank, Jr., of Berlin, on the uses, qualities, and methods of manufacturing calcium cyanamid or lime nitrogen, as developed by Dr. A. Frank, the father of the lecturer, and Dr. Nikodem Caro, both of Germany. The Deutsche Bank of Berlin, one of the great banks of the world, and the Siemens and Halske interests, the great electrical manufacturers of Germany, have been the financial support of the experimental and commercial efforts in connection with the production of lime nitrogen.

The subject of the address itself is of far greater importance to the world and of interest to all scientific men than its title would suggest, for it described the final accomplishment of a task which for one hundred years has been vigorously pursued by chemists and technical men, namely, the commercial production of a nitrogen fertilizer by the fixation of nitrogen from the atmosphere. The only natural deposits of nitrogen fertilizers are in Chili and these are being rapidly exhausted.

Economists, statisticians and the leading agriculturists of the various countries of the world have realized for a number of years that unless some practicable commercial means were developed of artifically producing a nitrogen fertilizer for the soil that the rapidly increasing population on the face of the earth, together with the continuous impoverishment of the soil of its necessary nitrogen contents, would bring the world face to face with starvation in a comparatively short time. The seriousness of the situation is naturally felt more keenly in the older countries of Europe where the people are more crowded upon the land and the soil has been cultivated for generations, and this fact, together with the well-known skill and patience of the German chemists, has led to a natural consequence in the final solution of the problem by German scientists.

Dr. Frank also discovered and developed the application of potash as a fertilizer and today it is one of the great industries of the world. Last year 350,000 tons of potash salts were imported into the United States from Germany.

The agricultural departments of various European governments have carried on continuous experiments with lime nitrogen as a fertilizer for various crops for the past five years. It seems that the value of a fertilizer can be determined only through a succession of yearly applications to the same fields, and it was only with the past year, or eighteen months that the exceptional value of lime nitrogen to vegetables, fruits and cereals and other crops, was thoroughly established in the minds of the government officials of the various European countries. Lime nitrogen has been produced on a commercial scale in German and Italian work for three years, and the latter works are now quadrupling their capacity, and in addition thereto, European works are in process of construction, whose initial capacity will be in the neighborhood of 50,000 tons per annum.

THE ELECTRIC FURNACE.

Few inventions have so greatly benefited the metallurgist as the electric furnace. It is not so very long ago that the highest attainable temperature by artificial means was about 2000 degrees centigrade. It is now possible, however, largely owing to the splendid researches of Siemens and others, to artificially produce temperatures far beyond this limit. We are thus able to fuse and otherwise handle in a commercial manner such hitherto refractory substances as carbon, platinum and chromium. Indeed, even the crystalline form of carbon, the diamond, which was once believed to be indestructible, can now be fused by the electric furnace. Such apparatus may be divided under two main headings, namely, those in which the heating effect is produced by the passage of the current through a resistance, which may be either a part of the furnace or may consist of the material to be treated in the furnace, or those in which the heating effect is produced by the electric arc established between two carbon or other electrodes connected with the source of current. To Sir William Siemens must be given credit for being the first to apply the electric-arc furnace to commercial operations. The British Aluminium Company utilize an electrolytic furnace for the separation of aluminium from a mixture of purified alumina and cryolite. Doctors Nernst and Glaser devised a resistance furnace which is based upon the fundamental principle of the Nernst lamp. Experience has proved that the resistance type of furnace is that most readily capable of efficient regulation. The best form of furnace seems to be that adopted at Niagara Falls, in which the heated column consists of a fused electrolyte maintained in a state of fusion by the passage of the current, and communicating its heat by diffusion and radiation to the charge which is packed round it. The measurement of the temperatures attained in electric furnaces is a very difficult matter, but by means of the thermo-couple it can be done fairly accurately. It is very difficult to estimate the extent to which electric furnaces are used, but at the end of 1900 it was estimated at 225,000 horsepower, of which about 70 per cent was employed for manufacturing calcium carbide. In the manufacture of aluminium 27,000 horsepower was used, and this figure is now greatly increased.

LAMP FIXTURES.

It is very encouraging to note the interest which architects and illuminating engineers are taking in electric light fixtures. Although it has been pointed out again and again that the design of fixtures has been left almost entirely to the fixture manufacturers, who have generally branched out into this business from that of making gas fixtures, the Electrical Review remarks that no concentrated effort has been made to overcome the objections to which this has led. It has generally been thought entirely satisfactory if a gas fixture be modified so that a lamp socket could be attached to it in place of the ordinary burner. Then some slight modifications, such as turning the lamp down, have been attempted, but no radical departure from the old ideas was made.

Along with this unfortunate condition was another: little attention was paid to directing the light produced by the lamps so as to get the desired effect. A lamp was placed in the socket, and if it did not give enough light in the direction desired, other lamps were added. Shades were frequently provided, but they were purely ornamental and useless for improving the illumination. Occasionally some very beautiful designs for electroliers have been seen, but too frequently they were merely ornamental structures which might just as well have been fitted with gas burners. In other words, little or no attempt was made to take advantage of the characteristics of the incandescent lamp other than to enclose it in an ornamental globe.

It is therefore very pleasing to find a healthy interest now being taken in these two phases of illumination. Architects and illuminating engineers are making their own designs for lighting fixtures, and are not restricted by the past history of gas lighting. And they are devoting a great deal of care to the selection of shades and reflectors which give the distribution of light desired for each room.

There is room here for the exercise of a great deal of taste and ingenuity, not only in the design of fixtures, but of shades; and there is a large and growing class interested to learn of the actual results obtained from any place where special attention has been given to the question of illumination. Data on this subject are, as yet, all too scarce.

SYNOPSIS OF ADDRESS DELIVERED BY RUFUS P. JENNINGS AT ANNUAL MEETING OF THE SOUTHERN CALIFORNIA EDITORIAL ASSOCIATION AT LOS ANGELES, APRIL 13, 1907.

In speaking in response to the allotted theme, "The Newspaper as an Agency of Promotion," Rufus P. Jennings, chairman of The California Promotion Committee, expressed his appreciation of the good work done by the press of the State, and said it had been a most valued agency for development and progress. He said in part:

"I want to express my appreciation in this public manner for the co-operation had in the work we have in hand. This co-operation has been splendid from one end of the State to the other, and it has excited fresh endeavor in all localities of the State.

"The criticism I am going to make is that some editors still seem to think that the only way to build up their localities is by disparaging other localities in California."

Mr. Jennings here read a number of clippings taken from newspapers published in San Francisco, the San Joaquin Valley, Los Angeles and other parts of the State in which invidious comparisons were made about other parts of California. He then continued:

"Does any one for a moment imagine that such articles as these do any one or any locality any good? They are intended to do harm to a part of California, and if successful in so doing can but act as a boomerang on the localities where the articles were inspired."

He then read extracts from papers speaking well of other parts of the State and pointed out how much better was this friendly way. He then read an article, most scurrilous and defamatory, that recently appeared, in "Democrat" of Madison, Wis., and said of it:

"An article such as this must have been inspired, and particularly is such a fact patent as it is similar to other articles now appearing in the Eastern press. How can such things be? How can any Californian imagine that his particular locality in California can be other than harmed by such sentiments?"

In speaking of State division he pointed out that such a division would not change the physical conditions of the country, and in this connection said:

"All the States of the Pacific Coast are linked together by close affiliations, and no matter under what names or forms of government, the interests of the entire Pacific Coast are interdependent."

In speaking of the power of the preess for good he said: "The newspapers have it in their power to change the attitude of the people of California or of those who do not yet understand the value of co-operation, by refusing to publish incorrect and unkind statements regarding any part of the State, and on the other hand to make it a point to publish news of a friendly character of other than their own localities."

He strongly advised co-operation of the press with the local organizations of the State, and said: "So I urge upon the newspapers to strongly support the local organization, and all these one hundred and seventy-five organizations centralized in The California Promotion Committee, with a membership of more than thirty thousand, with the backing of the press, make a force that is bringing continued and increased prosperity to all."

Mr. Jennings then extended an invitation to the members of the Association to attend the next semi-annual meeting of the Counties Committee of the California Promotion Committee, which will be held at Petaluma on June 7. The meeting will be devoted to the subject of "Forestry and Irrigation." He closed as follows:

"In closing I will say just a word regarding The California Promotion Committee. It is simply this: The Committee is persistently and effectively working for the entire State of California. It knows no north, no south, no east, no west. It is for the whole State—first, last and all the time. And the newspapers can be depended upon to continue to help in the work, I am sure."

LONG-DISTANCE POWER TRANSMISSION.

One of the most interesting, and at the same time one of the most important, papers read before the Institution of Electrical Engineers this session is Mr. J. S. Highfield's paper on the continuous-current series system for long-distance transmission. The system with which the name of that noted Swiss engineer, M. Thury, is associated has formed the basis of a series of far-reaching investigations by Mr. Highfield, and he concludes that M. Thury's apparatus, as improved and simplified since its first introduction in 1899, compares favorably with alternating-current apparatus, upon which so many minds have for years been at work. The problem has forced itself upon Mr. Highfield by reason of the fact that the company to which he is engineer has obtained certain powers of supply in a very large area, aggregating 300 square miles with a circumference of 80 miles, which it is desirable to supply through underground mains from a station situated on the circumference. The difficulties experienced with alternating currents, he says in his paper, can be eliminated only by the use of direct current, and he sets himself the task of examining what has already been done in this direction. One of the principal difficulties is that of resonance, which, of course, with continuous current is eliminated. The advantages and the limitations of the direct-current system are set out with fairness. After comparing the relative value of alternate and direct currents for long-distance power transmissions, Mr. Highfield indicates some of the possible directions in which the series system offers advantages over the parallel system. They are: (1) the ability to extend the possible commercial transmission distance far beyond that possible with alternating currents, and particularly in those cases where underground transmission is essential; (2) simplification of switch and regulating gear; (3) easy working of several stations in series on the same loads, so that the more efficient run always and the less efficient run only on the peak load; (4) the uniform section of the mains permits an increasing load supplied at first from one point to be readily provided for by the addition at any other suitable points on the main of other stations without addition to the cable system; (5) efficient speed regulation of sub-generators where certain special loads, such as chemical loads, are to be served from a distance; (6) greater all-round efficiency to be obtained when the generators are driven by turbine worked from a waterfall having a great percentage variation of head. In the short discussion which followed the reading of the paper, all the speakers confirmed Mr. Highfield's evidence as to the suitability of continuous current for long-distance power transmission. Professor Kapp gave some figures relating to the working of the continuous-current system in Switzerland, and a comparison between the two systems bringing 12,000 kilowatts to Zurich over a distance of 85 miles showed that, while the percentage of loss was higher in the case of alternating current than in the case of direct current, the cost of plant per kilowatt delivered was £21 for the direct current and £24 for the alternating current. The question is of importance to this country, and especially to London at the present moment. We may be a long way off from the time when the ordinary power supply stations now laid out on the alternating-current system will change over to continuous current, according to Lord Kelvin's prediction. But there is an unmistakable tendency now to go in for large supply areas, and it is in this direction that we might look for the development in this country of the system which is so successful on the continent.—The Electrical Engineer (London).

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EDITORIAL.

Testing of Electrical Machinery

The efficiency of electrical machines is the ratio between the in-put and the out-put of energy. The out-put is, for generators, electrical; for motors, mechanical. The in-put for generators is mechanical and for motors electrical. Some machines such as rotary converters or motor generator sets may have an in-put both electrical and mechanical and an out-put also a combination of both.

To determine the efficiency of electrical machines, it may be necessary to measure the electrical energy in-put or out-put and the mechanical energy in-put or out-put. Except for certain types of electrical transforming machines, it is therefore necessary ordinarily to make both electrical measurements and mechanical measurements. Though the accuracy of electrical measurements is rather higher than that attainable in other branches of engineering, notably the measurement of mechanical energy, it must be borne in mind that electrical measurements are not absolute. Direct current measurements are ordinarily more accurate than alternating current measurements and even special care is required in the measurement of either current or voltage for direct current to arrive within one-half of one per cent of the correct values. In dealing with high pressure wattmeters, either alternating current or direct current, it is quite difficult to attain results within one per cent, though the readings taken upon the instruments may be accurate within one-tenth of one per cent.

Mechanical measurements cannot be made to a degree of accuracy that is possible with electrical measurements. Taking into consideration this fact, it is quite necessary in the case of efficiency tests to allow a margin of error varying from one to two per cent, while even higher margins should be allowed in certain cases where the method of determination is indirect.

The determination of efficiency is much simplified if the efficiency of the engine or turbine and generator are not separately determined, but the unit as a whole considered. In this case, the efficiency will be obtained by indicating the engine or turbine and measuring the out-put of the generator. The simplicity of this method of determining efficiency and the importance of the result of the test from the standpoint of the purchaser has brought it into frequent use.

For the same reason it is often found that guarantees are based upon the relation of the amount of fuel required and the total energy in kilowatt-hours delivered to the switch board. The combined efficiency of the steam generating apparatus, the steam consuming machinery and the electric generators is thus determined without definitely establishing the actual efficiency of each portion of the apparatus making up the unit.

In the testing of electrical generators or motors in sizes above 300 to 500 horsepower it is usually found preferable to determine the ultimate efficiency by actual measurement of losses, rather than to measure the electric in-put or out-put and also measure the mechanical out-put or in-put. This is due primarily to the fact that the measurement of mechanical power in large units is quite difficult, due to the necessity of absorbing, more often wastefully than usefully, the entire out-put of the machine under test. In addition, as indicated above, the accuracy of mechanical measurements both by means of a brake or by indicator is much less than the accuracy of the electrical measurements. It has therefore been found desirable to avoid mechanical measurements and to determine the efficiency by measuring, usually electrically, the losses, the aggregate of which is the difference between the in-put and the out-put. It is also true that in many cases when dealing with the in-put and the out-put of electrical energy alone with such machines as static transformers, rotary converters and motor generators, more accurate results are obtained by determining losses than by comparing the in-put and the out-put. Again, the designer usually finds it necessary to calculate the losses and when the tests are made they are a check upon his method of computing the losses in the machine.

It has been found most misleading to accept as final the computed losses in electrical machinery. What are supposed to be the iron losses in machines are not in many cases the losses which occur in the unfinished

iron when the lines of force are not uniformly distributed in the iron core. There are in many cases additional losses due to varying density of the magnetic field, and in addition there are much more important losses due to hysteresis and eddy currents in other parts of the machine, whether solid or laminated. It is exceedingly difficult, if not impossible, to determine the data necessary for the computation of actual losses and rarely is it possible to obtain even approximate results by simple measurements of a test piece in the laboratory. As an illustration of this, it has been found in a number of actual tests that the so-called iron losses, including hysteresis and eddy currents, were from three to four and one-half times the losses as determined with a laboratory sample, the exact ratio depending upon the load on the machine. Therefore the most satisfactory method of making guarantees consists in basing the efficiency upon the most unfavorable values obtained from previous machines of similar construction. The actual efficiency will often be found to differ to a very considerable degree from those deduced as a result of theoretical considerations alone and which are many times the basis of the guarantees or performance specifications furnished by the manufacturer.

As a rule the purchaser of electrical machinery is only able to carry out tests upon a complete machine. On the other hand, the builder is in a position to make tests and repeated experiments during the construction not only of one machine but of a great many of the same type. The manufacturer is therefore able and should in all cases furnish guarantees which can be relied upon as representing the exact workings of the machine. Nevertheless, in determining the efficiency of large units by computation when assuming that the in-put is equal to the out-put plus the losses in the machine, the data provided by the manufacturer is found, when accurate tests are made by the purchaser, to be in many cases quite unreliable.

Electrical machinery should be judged upon other considerations than efficiency; reliability of operation as well as the maximum capacity with good regulation are both of great importance. One machine may stand an exceedingly high voltage test in the factory and break down when put in operation, due to the inferior lasting quality of the insulation used. The selection of the proper material by the manufacturer and the use of the same grade of material at all times may have as much to do with the success of a particular line of apparatus as high efficiency. The rating of electrical machinery is often indicated by the increase of temperature during a given period when operated at full normal load. The value of such a test depends largely upon the method of measuring the temperature rise. In some cases an ordinary mercury thermometer may be used. With this method it is seldom possible to measure the actual rise in temperature of the parts of the machine where most of the heat is concentrated or the actual losses take place. It is much preferable to measure the increase of temperature by measuring the increase of the resistance of the affected portions of the machine, if such a method can be used.

In general it must be admitted that laboratory or factory tests and commercial tests many times give widely varying results. This may be due to the difference in the conditions of operation when tests are made at the factory and the conditions under which machines are operated when finally installed in the plant. It is of much more importance that the commercial tests which will determine the durability, reliability, efficiency and capacity of the machine, give proper results than that the manufacturer's guarantees should be found correct immediately after the installation of the machine.

REMOVAL NOTICE.

The Electric Storage Battery Co., Philadelphia, Pa., announces the removal, on April 22, 1907, of its Pacific Coast Sales Office from No. 525 Thirteenth Street, Oakland, to temporary quarters at 11 Hawthorne Street, San Francisco. Later, notice will appear of its removal into permanent quarters now being prepared in the Crocker Building.

The operating department will be permanently located after April 1, 1907, at 11 Hawthorne Street, San Francisco.

The Pacific Coast stock of "Exide" and "Chloride" Batteries will be handled by, and may be purchased of the Exide Battery Depots, Incorporated, which will be permanently located at 11 Hawthorne Street after April 1, 1907.

R. B. DAGGETT,
Manager San Francisco Office.

PERSONALS.

H. B. Vanzwoll, secretary of the Sunbeam Incandescent Lamp Co., visited San Francisco very recently.

Mr. J. Frank Adams, general manager of the Southern Nevada Consolidated Telephone and Telegraph Company, has been in San Francisco during the past week.

Mr. A. N. Palmer, representing the Phillips Insulated Wire & Cable Co., and Mr. N. C. Brenner, proprietor of the American Insulated Wire & Cable Co., have recently paid a visit to the Coast in the interests of their respective companies.

A. L. Salt, general purchasing agent of the Western Electric Co., with headquarters in New York City, is visiting the Coast in the interest of this company, of which the California Electrical Works is the main western branch.

Mr. M. A. Farnsworth announces the severance of his connection as president and general manager of the Farnsworth Electrical Works, and Mr. Farnsworth has now established on his own account the M. A. Farnsworth Electrical Machinery and Manufacturing Works, at 16-18 Natoma Street, near First. In addition to the sale and rental departments containing a full line of new and second hand motors, transformers, dynamos and centrifugal pumps, a general repair establishment, thoroughly equipped with the most modern and improved machinery, has been installed, giving unsurpassed facilities for prompt and efficient service.

Mr. Fred R. Jenkins, representing the H. Krantz Manufacturing Company, has been in San Francisco for some time

looking for a desirable location. The Krantz Company's panel boards, switchboards, etc., are well known in Chicago and New York and no doubt are known to many of San Francisco's builders and architects. Among other well known installations, their apparatus has been used in the St. Regis Hotel, Hotel Astor, Hotel Belmont, Metropolitan Life building, and Wannamaker building, in New York; Marshall Field building, Mandel Brothers, Chicago Savings Bank, in Chicago; Bellevue-Stratford Hotel of Philadelphia, and many others.

ANNOUNCEMENT.

The Wagner Elec. Mfg. Co. of St. Louis desire to announce the appointment of Mr. F. Johnson, district manager of St. Louis territory.

Mr. Johnson has been connected with the sales organizations of the General Incandescent Arc Light Co., Stanley G. I. Co., and later with the General Elec. Co., having been located in St. Louis, representing these companies for the past eight years.

The completion of the new works of the Wagner Elec. Mfg. Co. in the outskirts, has made necessary the opening of a St. Louis district sales office, and this office will be located in the Frisco Building, Mr. Johnson or his assistants being available at all times for consultation on matters pertaining to the sales in the St. Louis territory.

TRADE CATALOGUES.

Woodin & Little have published a new catalogue (number 33) covering the specialties that they carry. These comprise pumps, windmills, tanks, gasoline engines, pipe fittings, etc. This issue supersedes all former catalogues and the company request that all old ones be destroyed. Those desiring copies address the firm, at 534-536 Mission street, San Francisco.

The Allis-Chalmers Company have issued a new corrected index, showing catalogues, bulletins, instruction books, etc., in force April 1st. This gives a list of one hundred and thirty-five (135) publications, each treating of a separate product or group of products of Allis-Chalmers Company. Among these are comprised their new line of bulletins, eighty-eight (88) in number. It will be observed that in addition to the numerical arrangement, they have the publications classified according to subject. This makes the index convenient for reference, and the feature is one which they intend to extend much farther in a subsequent edition.

CALIFORNIA PETROLEUM.

For a number of years California petroleum has shown an increasing output, and this increase will be marked in the statistics for 1906. A greater demand was created during the closing months of the year than at any previous time. This was doubtless due to the large contracts entered into with Japan, and the completion of the pipe line across the Isthmus of Panama, through which petroleum will be piped and supplied to the Atlantic Coast. Shipments are now being made to the Pacific terminal. The outlook for better prices is evident in the exceptional demand. A large amount of new territory is being prospected, and many new wells are being sunk in the proved districts. Owing to the low prices that formerly prevailed, and also to overproduction, comparatively little prospecting had been done for some time, and many strong producing wells were capped, but now all of this is changed, and every effort is being put forth to supply the present demand.—From "Mines and Minerals."

WORLD'S TRADES UNIONS.

The United States Labor Department publishes some interesting figures showing the number of members of trade unions in various countries. The following table gives a summary of what is shown in the report. The figures relate to 1905, except in the case of Australia, Italy, Holland and Norway, which refer to 1904.

	Members of Trade Unions.	Per cent of Population.
United States ....circa.	2,000,000	2.64
Great Britain and Ireland......	1,866,755	4.50
Germany	1,822,343	3.23
France	781,344	2.00
Austria	323,099	1.24
Italy	260,102	0.80
Belgium	128,700	1.92
Sweden	105,500	1.92
Australia	100,626	2.66
Denmark	90,911	3.71
Hungary	71,173	0.37
Spain	56,905	0.31
Switzerland	48,000	1.44
Holland	37,221	0.73
New Zealand	27,714	3.58
Norway	16,227	0.73

The membership of unions in the United States can only be stated approximately, as many organizations publish no figures at all and others publish unreliable ones. The American Federation is the largest Federation in the United States; at the end of 1905 it had 1,494,300 members. In addition to this body there are the seven railroad brotherhoods whose aggregate membership is 250,000, and a number of other smaller unions not belonging to the American Federation of Labor. From this table it appears that although the countries stand in the order shown as regards the total number of organized workers, yet, in proportion to the population, the United Kingdom has the largest number of trade unionists; Denmark coming second, New Zealand third, Germany fourth, while Hungary and Spain come last in the list with 0.37 per cent and 0.31 per cent respectively. Great Britain, which has a population only slightly greater than France, has more than twice as many members, and Australia and Denmark, both countries with small populations, have more organized workers than Hungary or Spain. On the whole, the Latin countries are far behind the Anglo-Saxon and Teutonic.

The Pacific States Telephone Company is to absorb the Nez Perce Co-operative Telephone Company, operating in Idaho, south of Spokane. The two organizations are rivals in the territory. It is understood that the $15,000 worth of new stock which the Nez Perce company is to issue in the near future is to be taken over by the Pacific States Company, which will give the latter the controlling interest in the farmers' line. The capitalization of the Nez Perce company is $10,000, and at a recent meeting of the stockholders it was voted to increase it to $25,000, the proceeds from the sale of the stock to be used for the improvement and extension of the company's plant and lines.

INDUSTRIAL

THE LAZIER GAS ENGINE.

A Miracle of Simplicity, Efficiency and Economy.

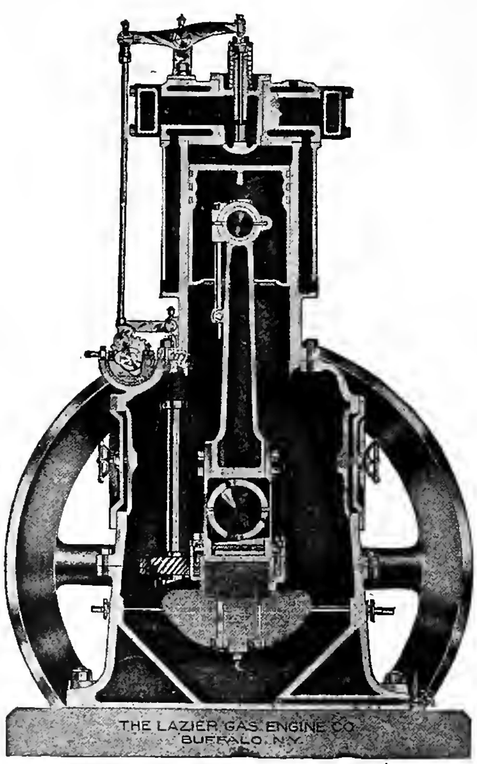
The evolution of power, from the primitive steam engine, crude and imperfect, but containing the principle which made possible the monsters of iron and steel, which have revolutionized the world, to the new mechanical marvel, the gas or air expansion engine, includes the history of all modern progress and all modern civilization.

With the steam engine, wonders were done—with the gas engine miracles have happened. With its aid, navigation of the air is an accomplished fact—automobiles skim the earth at a speed deemed, a few years ago, unattainable—submarine boats dive into the depths of the seas, like ducks—and power, which has multiplied a millionfold the productive capacity of human hands, has been placed within reach of even the farmer, to aid the bounty of Nature.

The principle of the gas, or air expansion engine was from the first accepted as a new and most important discovery in power development, which would eventually supersede steam, and since that time, the efforts of mechanical engineers have been directed to simplifying the engines into which this mighty power has been harnessed.

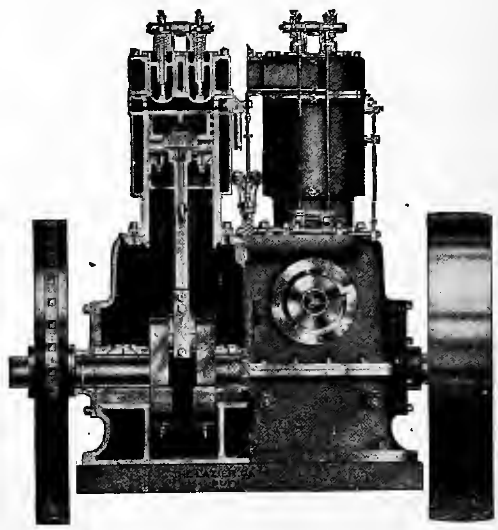
As no class of business men is more vitally interested in the question of economical power than the readers of this Journal, we believe a short description of the very latest type of gas engine, which has just been placed on the market by the Lazier Gas Engine Company of Buffalo, N. Y., will be of interest to them.

Mr. Arthur A. Lazier, one of the pioneers of gas engine



development, has been engaged for several years in the perfecting of a type of gas engine which would eliminate the objectionable features of the engine formerly in the market. Having at last succeeded, he recently disposed of his entire interest in the Lazier Engine Manufacturing Company and organized the Lazier Gas Engine Company, to enter upon the manufacture of what appears to be the perfect gas engine. He has associated with him in the company a staff of mechanical engineers, which includes some of the best known gas engine experts in the United States. Two large plants are now in operation, producing the Lazier gas engine.

In principle like other gas engines, the Lazier engine differs from all other engines in the simplicity of its construction, the almost utter impossibility of its getting out of order, and the fact that all the mechanism of the machine, instead of being on the inside of the engine, is on the outside, where inspection and repairs can be made without tak-



ing the entire engine to pieces.

In this engine the valves are operated mechanically, so that they cannot get out of order.

Ignition is of vital importance in a gas engine. In every other type of gas engine, if the igniter should fail to work or fire the gas, the engine comes to a stop and remains at a stop until repairs have been made. In the Lazier, a double system of ignition, which can be run either separately or in combination, has been provided, and is so arranged that the time of firing the charge can be changed while the machine is in operation.

Another new and striking feature of the Lazier is that the cams and cam shaft run in oil, but are still in plain sight of the operator at all times. The system of operating this cam shaft is also new, there being but four gears to the entire machine, and these being spiral gears and running in oil, make the operating almost noiseless. The usual objection to a vertical engine has been in the lack of a suitable method of taking up the lost motion in the connecting rod. In the Lazier, this is eliminated by the extended take-up, as shown in the cross section, end view cut. In fact, provision has been made throughout the entire machine for taking up the lost motion of all working parts.

The "splash" system of lubrication, which oils the engine automatically, is used and all Lazier engines are provided wih automatic self starters, enabling the operator to start the engine two minutes after stepping into the gas room.

One of the main features of special importance to the buyer is that the Lazier engine operates on almost any kind of fuel—alcohol, kerosene, distillate, illuminating gas or producer gas. The producer gas, which is made from ordinary hard or soft coal, is available in any part of the country.

With coal at $3 a ton a horsepower is produced for $4 per year, running constantly for ten hours a day, and the economy of operation over a steam plant of equal power will pay for the entire equipment in from eight to eighteen months.

The Lazier is made in all sizes from 2 to 300 horsepower, and the simplicity of its construction has enabled its manufacturers to place a machine far superior to any other type of gas engine on the market at prices much lower than any reliable machine has ever yet been sold.

FLEMING ENGINES.

About thirty years ago the Harrisburg Foundry and Machine Works of Harrisburg, Pa., began the manufacture of steam engines, and a steady progress in steam-engine design, together with the careful selection of materials and the employment of skilled workmen, resulted in such an extensive demand for the products of these works that it was necessary to rebuild them completely in 1900. The new works are distinctly modern in the character of their equipment, and their location in the heart of the great coal and iron state gives them superior advantages for securing raw materials.

The goal aimed at in the construction of Fleming engines has not been to produce prime movers of a low first cost, but, what is more important to the investor, engines characterized by reliability, high efficiency and long life, with but small outlays for repairs under exacting service. Special attention has been given to the subject of renewals. A complete system of interchangeable gauges for interchangeable parts, a full record of other parts from micrometer measurements, and a comprehensive system of pattern numbers insures a prompt response to orders for broken or worn out parts.

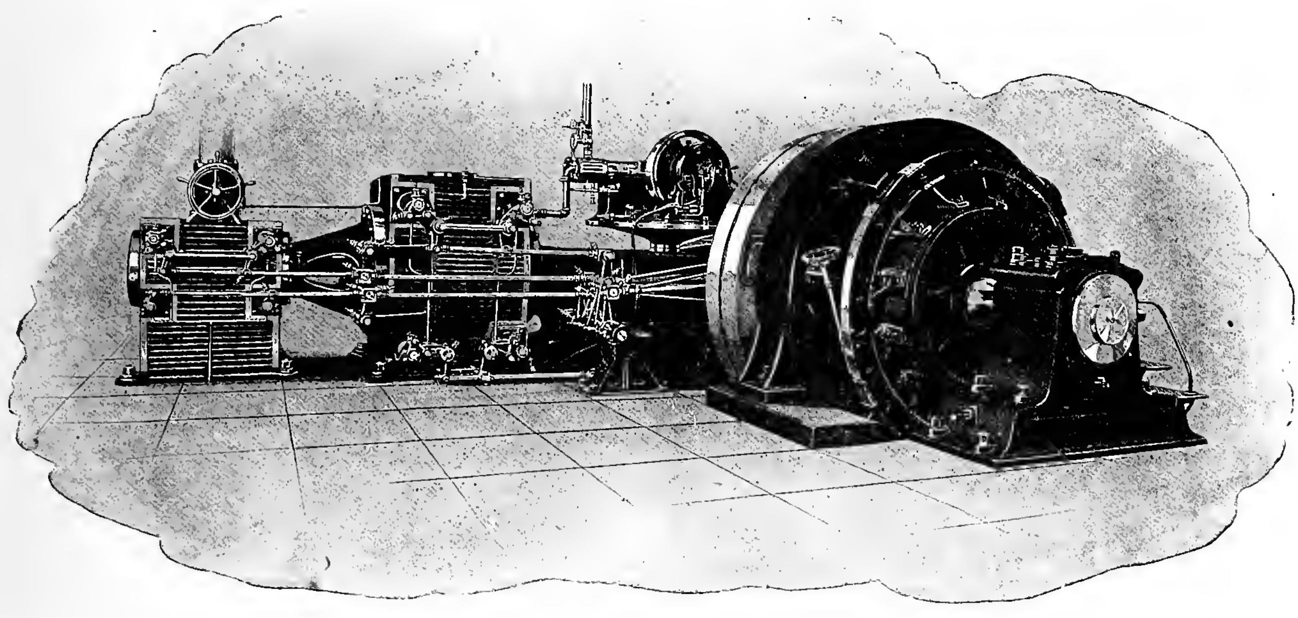
The Fleming engines of to-day differ from the Fleming engines of a few years ago, particularly in the disposition of the crank. A few years ago the engines were built entirely in accordance with the accepted centre-crank type of construction, but about 98 per cent. of the engines built at the present time are of the side-crank, two-bearing type. Some of the advantages of this kind of construction are the correct maintenance of perfect shaft alignment, the equal distribution of the pull on the two bearings of a belted unit, greater accessibility, small friction loss and economy in manufacture.

Another feature of Fleming engines is the self-lubricating, or "splash" system of oiling. By means of an ingenious and simple construction a considerable saving in oil is accomplished by freeing it from condensed water dripping from the piston rod.

The governor used is of the centrally balanced, centrifugal, inertia type. A fixed speed may be readily changed by adjusting the weights in the pockets provided at the ends of the governor arms, while small variations in speed may be obtained by changing the spring tension—a greater tension increases the speed. On the larger units, especially those used for driving alternating current generators, additional speed changing devices are supplied when so desired. These are operated either by electrical or mechanical means, or by both.

In the Fleming single-valve engines balanced piston valves operating in removable bushings, or cages, are used. Both valves and cages are made of close-grained, hard iron chilled in casting, which lends itself to accurate surface grinding and permits of a perfect steam tight fit.

The types of engines built by the Harrisburg Foundry and Machine Works are the Fleming simple, tandem and cross-compound single-valve engines, the Fleming simple, tandem and cross-compound four-valve Corliss engines, and the long-stroke Corliss engine. These are built in about nine hundred different styles and sizes for capacities ranging from 6 to 3,000 horsepower. That the Fleming, or Harrisburg engines are looked upon with great favor, especially on the Pacific Coast, will be readily seen from the following contracts recently placed with Charles C. Moore & Co., San



Francisco, who are the Pacific Coast agents:

A 300-kilowatt complete power plant for the city of Pasadena, to consist of Babcock and Wilcox boilers, Fleming four-valve engines, and a complete condensing equipment.

Two 200-kilowatt, Fleming four-valve engines for the Fairmont Hotel, San Francisco.

One 100-kilowatt Fleming four-valve engine for the Merchants Exchange building, San Francisco.

A complete 250-kilowatt electric plant for Taylor & Co., Oakland. The contract calls for Fleming four-valve condensing engines.

A 200-kilowatt Fleming engine for the Globe Grain and Milling Company, San Francisco.

Among the other contracts recently accepted by Charles C. Moore & Co. are the following:

A 1,500-kilowatt Curtis turbine for the American River Electric Company, together with the boilers, heaters, piping, erection, etc.

Two Ideal self-oiling engines for the American Biscuit Company, in addition to a Cochrane feed-water heater and purifier.

CHRISTENSEN PORTABLE AIR COMPRESSORS.

One of the most noteworthy developments in the history of mechanical progress, during the past few years has been the constantly increasing use of compressed air for a great variety of industrial purposes. Pneumatic tools and other appliances for the utilization of this product have been gradually introduced into one field after another, with such satisfactory results that the benefits to be derived from the use of compressed air, for operations covering a wide range of service, are now fully recognized.

In many cases it is also found advantageous to use an air-compressor which, with its various accessories, can be brought directly to the work, instead of having its product transmitted from a distance.

The best known and most serviceable machine of this type is the Christensen portable air compressor, now manufactured solely by Allis-Chalmers Company, the simplest form of which may be seen in the accompanying illustration. Many thousands of these compressors are in service throughout the United States, as well as abroad.

The equipment consists of the following parts:

1—Motor-driven Compressor.
2—Automatic Governor.
3—Switch and Fuse.
4—Reservoir.
5—Air Gauge.
6—Connection Pipe, Hose and Fittings.

The entire apparatus is mounted on an ordinary four wheel platform truck. The compressor is designed in the most compact form possible. Its connecting rods are operated by a drop forged steel crank shaft, set at such an angle as to give the best balance to moving parts. The crank shaft is extended at one end to receive a double helical gear, which meshes with the pinion of armature shaft directly above. The gear is cut with two keyways, which are placed at 90 degrees apart, so that when the teeth of the gear are worn on the sides, corresponding to the greatest pressure on the piston, the gear may be shifted at a corresponding angle on its crank shaft to present another set of teeth, thereby keeping the wear even. The motor base forms a cover for the compressor, and a suitable casing is provided for the gear. The compressor base is filled with oil at the filling elbow provided for that purpose, and all of the working parts operate in a bath of oil.

The motor for operating this compressor is of the series type (started and stopped without resistance of any kind) the coils of which are form wound and thoroughly insulated. It is very carefully built, both mechanically and electrically, and so constructed that the armature and fields can be removed, if necessary, without disturbing any other parts of the machine.

The automatic governor is so designed as to start and stop the motor compressor at minimum and maximum pressures, respectively. The mechanism of this governor consists of an ordinary pressure gauge which is actuated by the compressed air in the main reservoir. When the maximum pressure is reached, a contact is formed by means of this mechanism in such a way that the motor circuit is open, and upon lowering the pressure to the minimum point the circuit is closed, a magnetic blowout coil being provided for extinguishing the arc and preventing the burning of the contacts. All of these parts are accessible for inspection and repairs.

The reservoir is of seamless cold drawn steel, made in one piece, with the bottom pressed in and the end of the reservoir shell beaded over to form a joint, which is afterwards made solid and tight by brazing and tinning. These reservoirs are tested at 300 lbs. hydraulic pressure.

These compressors are furnished for capacities of 11, 16, 20, 50 cubic feet of free air per minute. Each is constructed throughout with sufficient strength to withstand a working pressure of 100 lbs. per square inch. The motors are designed for all standard voltages, as required.

A NEW HIGH PRESSURE INSULATOR.

Press dispatches state that Mr. Fred M. Locke, the pioneer in the manufacture of porcelain insulators for high pressure work, has after long experiment produced a new wonder in the insulator line which is exciting the most lively interest of high pressure electrical engineers. Under the most favorable circumstances, heretofore, it has been only with difficulty and danger that electric current with from 40,000 to 60,000 volts pressure has been transmitted; and even then insulation has been so imperfect as to cripple the service.

The new insulator produced by Mr. Locke permits the transmission of electric current up to any voltage desired. He claims that the range of insulation is unlimited, both electrically and mechanically.

Experts predict that the new Locke insulator will supersede all others on transmission lines where high pressure is desired. It is much less expensive than the insulators used at present.

ELECTRICALLY-DRIVEN PAPER MILL IN JAPAN.

Representatives of the Oji Paper Company of Tokio, Japan, have for some time been inspecting various electrical properties in the United States with an eye to installing a modern electrically equipped paper mill in Japan. As a result of their investigations, orders have been placed in the United States for a very complete electrical and mechanical equipment amounting to over a million of dollars.

The new Japanese paper mills, which will be operated by the electric drive, will include in addition to the motor equipment of the paper making machinery, a new hydro-electric plant, with a fifteen mile transmission line and sub-station. The electrical equipment will be furnished by the General Electric Company.

At the power station there will be installed four water wheel driven three-phase 3125 K. V. A. units, generating current at a potential of 3,450 volts, at a frequency of 60 cycles. Current for exciting the revolving fields of these generators will be furnished by the usual twin exciting units, consisting of two 150 kilowatt generators, driven respectively by an induction motor and a small water wheel. Generator regulation will be effected by a Tirrill regulator.

Twelve water-cooled, step-up transformers will be arranged in sets of three to raise the generator voltage for transmission. Each transformer will have a capacity of 1,050 kilowatts and the primary voltages will be arranged with Y connections for either 46,000 volts, 45,000 volts, or 44,000 volts. An eight-panel switchboard embodying the standard practice of the General Electric Company will be installed in the main station.

At the sub-station near the mill, twelve step-down transformers will be employed to reduce the transmitting potential to 2,200 or 2,100 volts. The switchboard will be arranged to distribute power at the desired voltage directly to the motors.

In the paper mill five 750 horsepower, 2,000 volt induction motors will be used to drive the pulp grinders. These motors are known as Form M, having an external resistance in the armature circuit and controllers to vary the speed. Each motor will have an extended shaft and will be so placed between two pulp grinders that both grinders can be driven directly without belting.

Four beater machines are to be driven, each by a 350 horsepower induction motor operating at a potential of 2,000 volts. A fifth will be driven by a 200 horsepower induction motor and all will be operated on the rope drive system.

The Oji paper mill will be situated at Hokaido on the seashore facing the Pacific. It will be an excellent example of modern engineering practice of which there are coming to be so many typical installations in Japan.

NEWS NOTES

TELEPHONES AND TELEGRAPHS.

New Westminster, B. C.—Hines & Austin contemplate the construction of a telephone line from Coquitlam to this city.

Marshfield, Ore.—The P. S. Telephone Company will erect a new exchange building at corner of C and Second streets.

Seattle, Wash.—The Pacific Coast Steamship Company is to equip all its boats running between this place and San Francisco with wireless apparatus.

Missoula, Mont.—The People's Telephone Company, capital $10,000, has been incorporated by F. M. Taylor, R. D. Prescott, J. A. Moss and W. R. Hamilton.

Waterville, Wash.—A new independent telephone line is to be constructed from Douglas ten miles east. Connections will be made into this place. George Ellis, promoter.

Salt Lake, Utah.—Adolph H. May, for the last three years manager of the Western Union Telegraph office, has just been made superintendent of the Pacific division, with headquarters in San Francisco.

Seattle, Wash.—Preparations of the United States government for a wireless telegraph station on Pier B are nearly completed and within a few days a station on the west end of Pier B will be commenced.

Farmington, Mont.—The Farmington Co-operative Telephone Company has been incorporated with a capital of $6,000 by H. R. Thompson, R. H. Wright and Ben Bollerud. The company will build lines to Chateau, Collins and Conrad.

Livingston, Mont.—The Shields River Telephone Company is planning to construct branch lines from Clyde Park to Cottonwood and Horse Creek and establish a toll line from Myersburg to this place. Forty miles of new line will be added to the company's system.

Sacramento, Cal.—Negotiations have been concluded for the absorption of the Capital Telephone and Telegraph Company of this city by the Pacific States Telegraph and Telephone Company. The former was established in 1895 for the purpose of opposing excessive charges by the Sunset Company. Long distance lines were extended to Folsom, Galt, Auburn, Placerville and most of the small towns in the counties near here.

Oakland, Cal.—Under a revision of the system of the Pacific States Telephone and Telegraph Company the Oakland division will include, besides Alameda and Contra Costa Counties, Del Norte south of Crescent City, Humboldt, Mendocino, Lake, Sonoma, Napa, Solano, Marin and Sacramento Counties. The new division will be in charge of John Kearns, one of the most experienced telephone men on the Coast. He was formerly in charge of the interests of the company in Sacramento and Coast divisions. Peter J. Lynch, division manager of the company, with headquarters in Oakland, has been promoted to the position of assistant general superintendent, with offices in San Francisco.

San Francisco, Cal.—Regarding a possible strike of the telephone operators, W. J. Phillips, division manager of the Pacific States Company, says: "There will be no strike of the telephone operators in our employ unless they bring it on themselves. We have our own reasons for opposing a union of operators, but we have been using no threats against the girls who belong to the new organization. Considerable misinformation has been circulated since the girls have shown a disposition to unionize. In the first place, the company has not been contemplating a reduction in wages. Quite the contrary, it has been for the past few weeks drafting a new scale, which will go into effect soon and materially raise the wages of operators. It was in course of preparation before the girls talked of unionizing. As for the recesses of the operators, they have not been abandoned. The company believes that lienency toward its employees pays, and it is its policy to cultivate it."

SPOKANE, WASHINGTON.

The Interstate Telephone System plans to expend $30,000 in improvements in Coeur d'Alene, Idaho, 34 miles east of Spokane. The Interstate begins with 500 subscribers. Fifty men are employed making the improvements. The harmonic system will be installed. There will be no cut in prices.

A telephone line has been constructed by the farmers along Bear Ridge, with centrals at Kendrick, Idaho, south of Spokane. There the line connects with the Interstate Cooperative line, which has connections all over Northern Idaho. Four farmers' lines are to be built into Kendrick this summer, and this will make that town the central for nine farmers' lines.

The rural telephone line known as the Barbee-Fletcher line, at Pullman, Wash., south of Spokane, recently sold to S. H. Breeze, has been consolidated with the Burgan-Hungate line. The lines will be known as the Breeze-Burgan Telephone System, and many new telephones will be added. This line accommodated a large district, giving the farmers connection with Pullman, through the Farmers' Telephone Office, with Colfax, Albion and more than 200 farmers' homes.

Spokane, Wash.—Stockholders of the Waitsburg Rural Telephone Company have granted a 10-year lease of the system to the Pacific States Telephone Company, which has been working two years to get control. The system comprises 21 lines and 200 instruments. According to the lease the contract can be terminated at the end of a year if the service is not satisfactory. The Pacific States Company is to keep the system in repair and charge the Rural stockholders at a fee of 25 cents a month. Lodges, halls, city halls and the school buildings have been donated a share of stock by the Rural company.

Spokane, Wash.—Officers of the Home Telephone Company announce that the new Spokane concern has no connection with the Home companies of California, except by long distance arrangement. In Spokane and in the State of Washington, the Home company is a separate organization from the California concerns, they say. For the State of Washington the Empire Electric Company has been formed to construct the lines of the Home company. Robert Tucker is president of the electric company. It is claimed the entire electric company was organized in this State for the purpose of avoiding labor troubles, and that there is no other object in the organization.

Spokane, Wash.—After three years' losing fight with the Independent concern at Wenatchee, Wash., west of Spokane, the Pacific Telephone and Telegraph Company has met the Farmers' Telephone Company with a flag of truce, making an offer which may result in consolidation. The proposition by the Bell people is to turn over all local business of the territory within certain prescribed limits to the Farmers' Telephone Company for ten years, and the Farmers' company is to take the long distance business on a commission. The boundaries embrace all of Kittitas County within a radius of 15 miles of the town of Wenatchee and all of Chelan County, east of a line drawn north and south, through a point two miles west of Peshastin and a line drawn

parallel to the six miles north of Wenatchee River. Z. A. Lanham is president and H. C. Littlefield is secretary of the Independent company.

Spokane, Wash.—The Pacific Telephone & Telegraph Company and the Farmers' Company, of Wenatchee, Wash., west of Spokane, have come to an agreement, after a conference by G. B. Bush, of San Francisco, and F. R. Bingham, of Spokane, with officials of the last named concern. Under the provisions of the understanding the Pacific company is to turn over its local and long distance business at once, and the two systems will be combined as soon as the change can be made, and not later than May 1. A three-section, multiple, common battery switchboard will be installed, and a new long distance section will be put in. The Pacific company agrees to remain out of the local field for ten years. The Farmers' company has completed its line to Peshastin, and is now constructing a line from the Dunkard settlement to Monitor. The company was incorporated in 1903. Z. A. Lanham is president and H. C. Littlefield is secretary.

Spokane, Wash.—F. C. MacGougan, manager of the Pacific Telephone & Telegraph Company, announces that from $500,000 to $750,000 will be expended in Spokane in the betterment of the service. The company has under consideration the erection of a new exchange building to be fitted with a class B switchboard, while another plan is to erect one or two branch exchanges to be operated in connection with the present plant.

Every telephone in Spokane will be exchanged, a new instrument of the latest model being installed in place of those now in use. That this may be accomplished a great deal of inside wiring is necessary, and this is being attended to by a staff of forty men. Under the new system the batteries now in use at the telephone stations will be thrown out, and in their stead the required energy will be supplied by big storage batteries in the central office. This will prevent trouble with telephones due to defective batteries.

When the improvements are completed 95 per cent of the Bell telephone wires in Spokane will be in cables, either underground or overhead. There are on hand for this work 88 miles of aerial cable, so that no delay is anticipated. Twenty-two miles of underground cable and 30 miles of aerial cable are now in use. Where underground work is done the block system is used, the telephone in one block reaching the conduit via a single pole, which is placed generally in the center of the block. Putting the plant on an all-cable basis will cost several hundred thousand dollars.

Mr. MacGougan made this official announcement:

"The company is making preparations to provide service which shall be adequate for a city several times the size of Spokane, now with 100,000 inhabitants. The officials in San Francisco are watching closely the growth of the cities on the Pacific Coast, and have been most favorably impressed with the progress Spokane has made in the last few years, and with its prospects for future growth. In the telephone building, erected seven years ago, and enlarged four years later, and which may have to be still further enlarged, thirty-five electricians have been working since last July, changing the distributing frame to new standard model. It is expected that this work will be completed in two months.

"Every bit of old equipment in the exchange is being replaced with an outfit of the latest model. The switchboard, a local battery express board, is being changed to common battery multiple. The work should be completed by the time the distributing frame is remodeled. The advantage of the No. 1 common battery board is that it makes possible quicker service, with fewer mistakes. With the new board every subscriber may be reached at any time by every operator. The board has a capacity for 9,600 lines, but can attend to more than 11,000 subscribers, since several may have telephones on one line. The 9,600 'jacks' which are used in making connections, are repeated at intervals of a little more than five feet, and each operator can reach every one of them.

"When the improvements in the switchboard now in progress are completed the enlarged capacity will be required to attend the business now in sight. It will be necessary to make immediate preparation for enlargement, and the engineers are considering which method will be most advisable. The new switchboard is being equipped to its fullest capacity and there will require 46 operators in addition to 150 now employed. The addition of a board will provide immediate accommodation for 5,000 additional lines. The new toll board, provided for in the engineers' estimates, is necessary to attend to constantly increasing long-distance business."

TRANSMISSION.

Los Angeles, Cal.—The Pacific Light and Power Company has petitioned for a franchise to put up poles and wires along every public road in the county except those in incorporated cities.

Oakland, Cal.—A special dispatch from New York states that one of the directors of the Western Power Company gives out that his company will erect a steam plant in San Francisco or Oakland. Between $2,000,000 and $3,000,000 are involved in the deal.

Redding, Cal.—A party of Portuguese laborers has arrived at Manton to work on the large reservoir of the Northern California Power Company at Macomber Flat. Water is to be carried to this reservoir from Manzanita Lake, near Mt. Lassen. A telephone is to be strung from Manton to Macomber Flat.

Santa Cruz, Cal.—Mr. Sterling has charge of the erection of the new powerhouse at the beach, for which the pile driving has already begun. Only sufficient machinery will be installed at the outset for the development of 900 horsepower, but it will be possible later to increase the output to 4,000 horsepower. The plant is expected to be running within a month.

Johnnie, Nev.—A big move in mines, railroads, timber and farming lands is under way in this vicinity. The Brock-Miller interests, owning the Tonopah and Goldfield Railroad, are expected to continue their line south through Johnnie to Tecopah, Cal., some sixty miles south of Johnnie. In this connection there will be launched, according to latest reports, a big agricultural, mining and power enterprise. By utilizing the water obtainable, it is expected that electricity will be generated sufficient for mining and lighting and the operation of the railroad.

Chico, Cal.—William H. Bissell, purchasing agent for the Great Western Power Company, states that on account of the storm and the loss of the Oroville bridge, his company would change its headquarters to either Durham, Thermalito or Chico. The base for forwarding supplies will be Durham and everything will be hauled by wagon from there. The damage at Big Bend was not so heavy as first reported.

The National Brake & Electric Company of Milwaukee, Wis., reports that as a result of the passing of the recent traction ordinance in Chicago, the Chicago City Railway has given instructions to proceed at once with the filling of an order for three hundred of the new National air brake equipments, which had been placed some time ago. This is one of the largest recent orders for air brake equipments for electric cars placed, and brings the total number of National equipments, in service on the Chicago City Railway, to the imposing total of nearly one thousand.

TRANSPORTATION.

Portland, Ore.—Negotiations are in progress for the establishment of a car building plant here. The site of the proposed works has not been fully determined. Walter H. Judson, Portland agent for the Evans Railway Equipment Company, is at the head of the corporation. A number of Portland capitalists are interested with Mr. Judson, and a fund of $500,000 has been raised to effect the organization.

Sacramento, Cal.—After many months of delays through the action of the storms and floods, the Northern Electric Railway Company, which is building a network of interurban lines throughout Sacramento Valley to center here, has commenced tracklaying within the city. Great activity is reported from the construction camps along American River, and when summer is fairly opened Sacramento will have been connected by trolley with all the important cities and towns in this valley.

Santa Cruz, Cal.—Two more condemnation suits have been filed by H. A. V. Torchiana, attorney for the Union Traction Company, with the county clerk for a double track right-of-way through the lands of Lucy Salomonson and Lucy Winkle, who own adjoining properties near Rodeo Gulch. A section in each of the complaints outlines the route to be followed by the extensions which will be added to the electric system of this city. It is proposed to extend the Capitola line from Capitola to Soquel to Santa Cruz.

Long Beach, Cal.—The Pacific Electric line is to build a branch line from the proposed Wilmington electric road from the intersection of Water street and the continuation of Twelfth Place to the end of St. James Place, at Knoll Park. It will connect there with the proposed Daisy avenue extension, which will be built around Knoll Park on the Lome Vista drive, and thence around the bluff down Ocean Park avenue, connecting with the main West Long Beach line at the corner of Ocean Park and West Ocean avenues.

Mill Valley, Cal.—Owners of the Mt. Tamalpais Railroad have about completed a new branch line for their mountain system. It starts from the main line at the famous double bow-knot and in a distance of five miles drops 1,000 feet near the edge of a redwood forest covering 600 acres. At the end of the road cottages and a hotel are to be erected 600 feet above sea level. It is the intention to connect the hotel and forest by an incline railroad. It is expected that all these improvements will be completed by July 1st. Trains are to be run direct from San Francisco to the forest in connection with the ferry system of the Northwestern Pacific road via Sausalito and Mill Valley.

Berkeley, Cal.—Application will soon be made by the Key Route for the privilege of laying another double track road. Having just been favored with one permit to double track Claremont avenue, they will again ask the trustees for a franchise from Fortieth street along Sacramento to Hopkins street. Sacramento will be widened to 110 feet and made a great thoroughfare through that part of Berkeley, as Adeline is further eastward. The Key Route and Harold Havens own the entire east side of Sacramento street from Fortieth to Hopkins and the widening of the street will be off their property and not affect any of the private owners. There will be a station built at Ashby, Dwight Way, University and Hopkins street. It is the intention of the Key Route to run 40-minute trains at first. As soon as the traffic will warrant it, they will put on a 20-minute service from Fortieth to Hopkins. Havens will soon put his property on the market, and that near the proposed stations will be first offered for sale. The new Key Route line will place this district in direct communication with San Francisco and will be an active competitor with the Southern Pacific lines.

ILLUMINATION.

Alameda, Cal.—Bids have been advertised for by the Board of Trustees for a water tube boiler, together with certain steam pipe work for the municipal electric light plant.

Wallace, Idaho—The Horn Silver Mining Co., which owns a group of claims on Placer Creek, is considering the installation of a mill.

Newport Beach, Cal.—According to the plans of Horace Slater this place is to have a gas plant by the first of June. The promoter is a citizen of Redlands.

Los Angeles, Cal.—Officers of the Los Angeles Gas Company have taken out a permit for alterations to the company's plant at No. 552 South Alameda street. The cost of the improvements will be $40,000. Parkinson and Bergstrom are the architects.

Los Angeles, Cal.—Property owners on Twenty-eighth street between Figueroa and Hoover, have petitioned that boulevard lights be placed at each alternate space of one hundred feet. These lamps are to be placed on the lot line so that the illumination be not lost in the trees.

Riverside, Cal.—Definite action has been taken by the City Trustees toward installing an ornamental street lighting system on the main business streets of the city. All overhead wires on Main street from Sixth to Tenth and on several other principal avenues, will be removed and placed under ground.

Los Angeles, Cal.—The City Gas Company has ordered materials for the erection of a complete plant, and as soon as they arrive actual work will commence. Every effort will be made to have the plant in working order before the cold weather this fall, and the mains of the company will be extended as soon as the pipes can be laid.

Vallejo, Cal.—Owing to the continued agitation here for a better service and lower rates for electric lights and power, the application of Henry Brown for a franchise to run lines over the county highways in Napa County, including a line on the Vallejo road as far as the Solano County line, has attracted more than passing attention. K. Casper, who made his start in the electric field in Grass Valley pprior to the advent of the Bay Counties Power Company, owns the local system. Some are of the opinion that the Great Western Power Company of Oroville is behind the application of Brown.

San Francisco.—The loss at the plant of the gas company, which was damaged by fire April 2, is not so large as was at first supposed. F. V. T. Lee, assistant to the president of the company, says: "I think that $250,000 will easily cover the loss. It is hard to estimate the exact damage, but I am sure that it will not exceed that figure." Chief Engineer F. H. Varney, who was in charge of the station, says: "All the generators are practically intact and will be running immediately. The greatest damage was caused by the fall of 400 tons of roofing. For a time we feared that our plant was totally ruined."

Fresno, Cal.—A mass meeting has been held in the Joss house here and preliminary arrangements were made for the formation of a gas company to be controlled by Chinese. The Mongolians claim that there has been discrimination against various parties in Chinatown, and believe that they can save money by having a company of their own. A site in the center of Chinatown has been secured and the price stated in the option is $1,400. The plant is to cost $14,000. To insure the stability of the company, those using power will be required to contract to stay with the Orient Company. The directors are confident of being able to make all stores come into the combine to buck against the San Joaquin Power Company, which is now supplying Chinatown.

FINANCIAL.

Anaheim, Cal.—The Section 2 Water Company has let a contract to Emmett & Dyer for installing two 12-inch wells. It is the intention of the company to install a 50 horsepower engine and develop 150 inches of water.

Los Angeles, Cal.—On April 1 the city council adopted the ordinance of intention and resolution declaring that the public interest demand bringing the waters of Owens River to this city, and that the cost will be $23,000,000, and that an election shall be called to vote upon an issue of bonds for that amount. It is expected that the election will take place near the end of May.

San Francisco, Cal.—Following the action that caused all members of its affiliated unions employed on the Fairmont Hotel to quit work, the Building Trades Council at its meeting last week expelled Electrical Workers' Union No. 6. The latter organization has withdrawn its men from the big hotel, and it is expected that the work will go on with the Building Trades Council in full control.

Riverside, Cal.—Because the Lake View Water Company has defaulted in the payment of interest on $65,000 worth of bonds, the Los Angeles Trust Company, the holder of the bonds, has been given permission to sell all of the property of the Lake View Company in the San Jacinto Valley. The property includes about 700 acres of land, together with flumes, pipe lines, reservoirs, and pumping plants, all of which were given as security for the payment of the bond issue and interest. The bonds were issued May 1, 1903, and payable in twenty years.

San Francisco, Cal.—In his testimony before the Grand Jury recently, Captain A. H. Payson, president of the Spring Valley Water Company, is reported to have said: "Spring Valley is on its last legs. It is crippled financially. The litigation with the city and the decree of forfeiture, while it is illegal, has served to impair our credit. People will not invest in Spring Valley bonds. San Francisco is in a serious predicament. What is to be done to protect the city's water supply and to guard against fire? Spring Valley stock is widely scattered among poor and rich. One assessment of $3 a share has been levied and collected. It would be a hardship to rush another assessment." Captain Payson asserted that practically all of the $840,000 raised by the $3 assessment has been spent, and that the company has sold its building at the corner of Stockton and Geary for $500,000 in order to get ready money for rehabilitation. He stated that the 25 per cent reduction on rates made by the Supervisors would be contested in the courts, alleging that it amounts to confiscation of the property. It was made evident that the company had not been guilty of bribery.

Tucson, Ariz.—At a meeting of the board of directors of the Tucson Gas, Electric Light and Power Company it was voted to increase the capital stock to $500,000 in order to provide for future construction, equipment, etc.

San Francisco, Cal.—The combined earnings of the United Railroads of San Francisco and the Philadelphia Company for 1905 and 1906 are as follows:

	1905.	1906.	Increase.
Gross earnings	$24,229,062	$24,533,603	$304,541
Operating expenses and tax,	12,535,503	12,746,041	210,538
Fixed charges, sinking fund, etc.	6,614,289	6,849,550	235,261
Net earnings	11,693,559	11,787,562	94,003
Surplus	5,079,270	4,938,012	141,258

Monrovia, Cal.—An ordinance has been adopted providing for an issue of $20,000 bonds for the acquisition, construction and completion of a city pumping plant and accessories for the water system at the wells known as the Chapman Wells. Also the sum of $10,000 is to be raised for pipe lines and conduits and $5,000 for improving the present mountain pipe system.

POWER AND LIGHT PLANTS.

Lethbridge, Alta.—The Lethbridge Electric Co. has decided to expend $25,000 this year in improvements. M. Freeman, manager.

Boise, Ida.—The Great Shoshone & Twin Falls Water Power Co. has been organized with a capital of $1,500,000. W. S. Kuhn, president.

Bandon, Ore.—Edwin G. Ames and Hollopeter Bros. have been awarded the contract for the establishment of a light and power plant at this place.

Oregon City, Ore.—The Portland Railway Light & Power Co. will expend $100,000 in the erection of a new power plant on the east side of Willamette Falls.

Grass Valley, Ore.—Council has purchased an electric light plant from the Fairbanks-Morse Co. for $3,052. The plant is to be in running order in ninety days.

Salem, Ore.—General Manager Sykes, of the gas plant, announced that the plant will be entirely remodeled and converted into an oil burning plant at a cost of $20,000.

Waitsburg, Wash.—The Waitsburg Electric Light Company, capital $350,000, has been incorporated by Arthur T. Roberts, Emmett R. Henderson and C. E. Bateman.

Wallace, Ida.—The Inland Power Company, capital $300,000, has been incorporated by G. Scott Anderson, S. P. Wright, W. H. Hall, J. J. Maloney and W. W. Bacon.

Seattle, Wash.—The Seattle-Tacoma Power Co. has applied for a new franchise till 1930 to furnish steam heat and hot water to the business district bounded by Madison Street, Fifth Avenue, Pike Street and the water front.

Tacoma, Wash.—The Mendenhall Power Company, capital $1,000,000, has been incorporated by W. J. Sutherland, B. M. Behrends, R. T. Laffoon, M. L. Clifford and L. J. Pentecost. Principal place of operating department, Juneau, Alaska.

Prince Albert, Sask.—Council has awarded contracts to Goldie & McCullough, Montreal, Allis-Chalmers, Montreal, and the Canada Foundry Co., Ltd., Montreal, for improvements and extensions to the electric lighting plant to cost $26,237.

New Westminster, B. C.—W. V. Hunt, Vancouver, of the B. C. Electric Railway Co., has been appointed engineer in charge of the work of installing the new water power units at Lake Huntington. Three units of 10,000 horsepower each will be added at a cost of $250,000. R. H. Sterling, Vancouver, is general manager.

Spokane, Wash.—W. H. Wilcox, manager of the Home Telephone Company, announces that the phone numbers used by his company will be identical with those employed by Pacific States Company. Numbers containing four numerals will be the same on the two systems, with the exception that a letter will be substituted for the "Main," and where the number now in use contains only three numerals an additional number will be prefixed.

WATERWORKS.

Los Angeles, Cal.—Sewell W. Thompson, a millionaire, and Gregory C. King, a mining man, propose to the city of Los Angeles that they be allowed the privilege of supplying water here at an output of $2,500,000. They have employed men to make preliminary surveys and have carried their investigations to a point where they can state definitely what amount of water they can secure and what will be the cost of a conduit, etc., for carrying it. The facts will be published in a few days. The bond election will not be held until about May 1st.

Imperial, Cal.—At a meeting of the Trustees last week a resolution was passed declaring that the water system was inadequate for the town, and the board instructed the town engineer to report on the works needed and the prospective expense of an entirely new system, to be built by the town. The proposed system shall be provided with cement settling basins, filtration systems, and an adequate pumping plant. The board also expects to install a power plant for supplying the town with electricity. It is proposed that bonds be issued by the city to cover the cost of the improvements.

Los Angeles, Cal.—Mayor A. C. Harper and the members of the City Council are convinced that some adequate and easily accessible water supply must be appropriated to tide the city over until the completion of the Owens River work. It may be said that they propose to conserve the water of several streams into a watershed comprising 650 square miles and capable of furnishing a constant flow of 7,000 inches for the city's use. Among those streams are the Piru, Castaic, Santa Clara, Elizabeth, and several other creeks. The Trustees have planned to carry the water through a main steel pipe which will bear the flow to Los Angeles. In the system as outlined there will be eighteen reservoirs. It will cost from $7,000 to $10,000,000.

CLASSIFIED LIST OF ADVERTISERS

INCORPORATIONS.

Coalinga, Cal.—The Coalinga Southern Oil Company has been incorporated with a capital stock of $100,000. Behind the project are H. S. Bridge, J. F. Lucey, J. A. Punting, H. H. Welsh and T. Spellacy.

San Jose, Cal.—The Los Gatos Ice, Gas and Electric Company has been incorporated with a capital stock of $200,000. The directors are G. W. and C. E. Hume, Jay Deming, J. D. and Bessie Farwell.

Bakersfield, Cal.—The Ricardo Land and Water Company has been incorporated with a capital stock of $1,500,000. The directors are Rudolph Hagen of Ricardo, A. M. Lyon, J. S. Green, J. V. Ham, Charles E. Smith and H. P. O'Connor of Los Angeles.

San Jose, Cal.—The San Jose Traction Company has been incorporated with a capital stock of $1,000,000. L. F. Hanchett has taken the greater part of the stock subscribed. The other holders are John Martin, S. S. Baldwin, C. C. Benson and E. M. Rea.

Wallace, Idaho—The Tam O'Shanter Mining Co., capital $1,000,000, has been incorporated by D. C. Coates, C. E. Gammell, Samuel Hull, J. J. Curran and M. A. Curran. The Gold Crag Mining Co. has been incorporated by Steward Fuller, R. J. Fuller and B. O. Skonnord, capital $1,500,000.

OIL.

Los Angeles, Cal.—It is announced here that the Union Oil Company's pipe line across the Isthmus of Panama is in readiness to use, and the pumping of oil through the pipe from steamers on the west side to those on the east side will begin shortly. Two vessels are now loading at Port Harford with cargoes of oil for the isthmus. The capacity of the pipe line is 25,000 barrels daily, and it is expected to be a great aid to the development of the oil industry on the West Coast.

Paso Robles, Cal.—D. F. Swarts of Los Angeles, supposed to be acting for the Union Oil Company, has taken a lease of the Winteroll place of 1,600 acres located near here and agrees to go to work developing it for oil within sixty days. A company has leased four sections of the Nacimiento ranch and agrees to go to work at once. The lessee is also said to be an agent of the Union Oil Company.

Bakersfield, Cal.—The first shipment of pipe for the new line of the Standard Oil Company to the oil fields of the Midway and McKittrick districts has just been received here and work is to be started at once. The building of the line, which will be sixty-eight miles in length, is the result of a contract recently signed by the independent producers of the fields by which the Standard obtains the oil of the district for thirty cents a barrel.

ELECTRIC RAILWAYS.

Boise, Ida.—S. E. Burnham was awarded the contract for laying the track for the Boise Rapid Transit Co.

Cheney, Wash.—The W. W. P. Co. has accepted the terminal site and will soon begin the construction of a depot and freight sheds.

Southeast Seattle, Wash.—The Seattle, Renton & Southern Ry. is replacing its old rails between Seattle and Columbia with 80-pound rails.

Tacoma, Wash.—Construction work will begin at once on the spur track from the Stellacoom line into section 11, by the T. R. & P. Co.

Boise, Ida.—Two carloads of electrical machinery for the Boise & Interurban have arrived and will be installed at once in the sub-stations.

Spokane, Wash.—The Spokane & Coeur d'Alene Electric Ry. has commenced the work of double tracking its line between Greenacres and Spokane Bridge.

Tacoma, Wash.—The Tacoma Railway & Power Co. will soon commence the extension of the American Lake line to Murray, a distance of about three miles.

West Seattle.—The West Seattle branch of the Seattle Electric Co. is being extended to effect a junction with the Fauntleroy Park at California Avenue and Ninth Street.

Seattle, Wash.—The Seattle Electric Co. has applied for a franchise on North Forty-fifth Street from Meridian Avenue to Fourteenth Avenue, n. e., the line will connect the Green Lake and University lines.

Missoula, Mont.—The Missoula Bitter Root Co. has been organized with a capital of $40,000 by P. J. Shannon, O. Blood, of Hamilton, J. L. Humble, of Corvallis, E. O. Lewis, of Stevensville, and P. M. Reilly, of this city. The company will construct and operate an electric line from Hamilton to this city through the Bitter Root Valley.

Everett, Wash.—Commissioners granted a franchise to the Puget Sound, Skykomish & Eastern Ry. Co. to build an electric line from Index, a distance of one and one-half miles; also to construct telephone and electric light systems.

Seattle, Wash.—The Seattle Electric Co. was granted a permit to double track its line between Fremont and Ballard.

Oregon City, Ore.—The Oregon City, Beaver Creek & Molalla Ry. Co., capital $100,000, has been incorporated by Grant B. Dimick, Thomas F. Ryan and J. W. Sherman, of Portland. The company proposes to construct and operate a steam or electric railway from this place to Beaver Creek, Highland, Liberal, Molalla and Wilhoit Springs.

CLASSIFIED LIST OF ADVERTISERS—CONTINUED

Pumps, Steam
Allis-Chalmers Co.
Henshaw, Bulkley & Co.
Moore & Co., Chas. C., Inc.
Risdon Iron Works
C. H. Wheeler Mfg. Co.

Railroad Supplies.
Johns-Manville Co., H. W.
Tel. and Elec. Equipment Co.

Roofing
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Northern Electrical Mfg. Co.
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Century-Klein Electric Co.

Surveying Instruments
Dietzgen Co., Eugene

Switches
Pacific Electric Mfg. Co.
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Switchboards
Bossert Elec. Cons. Co.
California Electrical Works
General Electric Co.
Standard Electrical Works
Westinghouse Elec. & Mfg. Co.
Wagner Elec. Mfg. Co.
Century-Klein Electric Co.

Tape
Okonite Co., Ltd.
Century-Klein Electric Co.

Telegraph Apparatus
Century-Klein Electric Co.

Telephones and Supplies
Brooks-Follis Elec. Corp.
California Electrical Works
Century-Klein Electric Co.
Standard Electrical Works
Tel. and Elec. Equipment Co.

Telephone Desk Sets and Hand Microphones.
Holtzer-Cabot Elec. Co.

Telephone Receivers and Cords.
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Tile Flooring
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Fort Wayne Electric Works
General Electric Co.
Standard Electrical Works
Westinghouse Elec. & Mfg. Co.
Wagner Elec. Mfg. Co.
Century-Klein Electric Co.

Turbines, Steam
Allis-Chalmers Co.

Traps, Steam
Moore, C. C. & Co., Inc.

Underground Electrical Conduits
Pierson, Roeding & Co.

Vibrators
Pacific Electric Mfg. Co.
Holtzer-Cabot Elec. Co.

Valves
Moore & Co., Chas. C., Inc.
Standard Elec. Works

Water Wheels
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Abner Doble Co.
Pelton Water Wheel Co.
Moore, Chas. C. Co., Inc.
I. P. Morris Co.

Water Wheel Governors
Allis-Chalmers Co.
Pelton Water Wheel Co.
Pierson, Roeding & Co.

Wires and Cables
California Electrical Works
Century-Klein Electric Co.
Okonite Co., Ltd.
Nat. Conduit & Cable Co., The
Roebling's Sons Co., John A.
Simplex Electrical Co., The
Standard Electrical Works
Standard Undergrnd. Cable Co.
Tel. and Elec. Equipment Co.

Woodworking Machinery
Henshaw, Bulkley & Co.

The JOURNAL OF ELECTRICITY POWER AND GAS

WITH WHICH IS INCORPORATED

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Storage Battery Plant for Regulation and Carrying Peak of Load in Electric Mining

The accompanying drawing and illustrations show the arrangement of a storage battery plant, and accessory apparatus, as well as the generating station, for regulating and caring for the peak of the load in electric mining service at Gross Rhuden, Germany, at the Gewerkschaft Karlsfund mines. It is stated that this accumulator plant exerting a buffer effect on the rotary current system, and thus providing a uniform load on the generators, is the first of its kind installed recently by the Accumulatorenfabrik of Hagen in Westphalia.

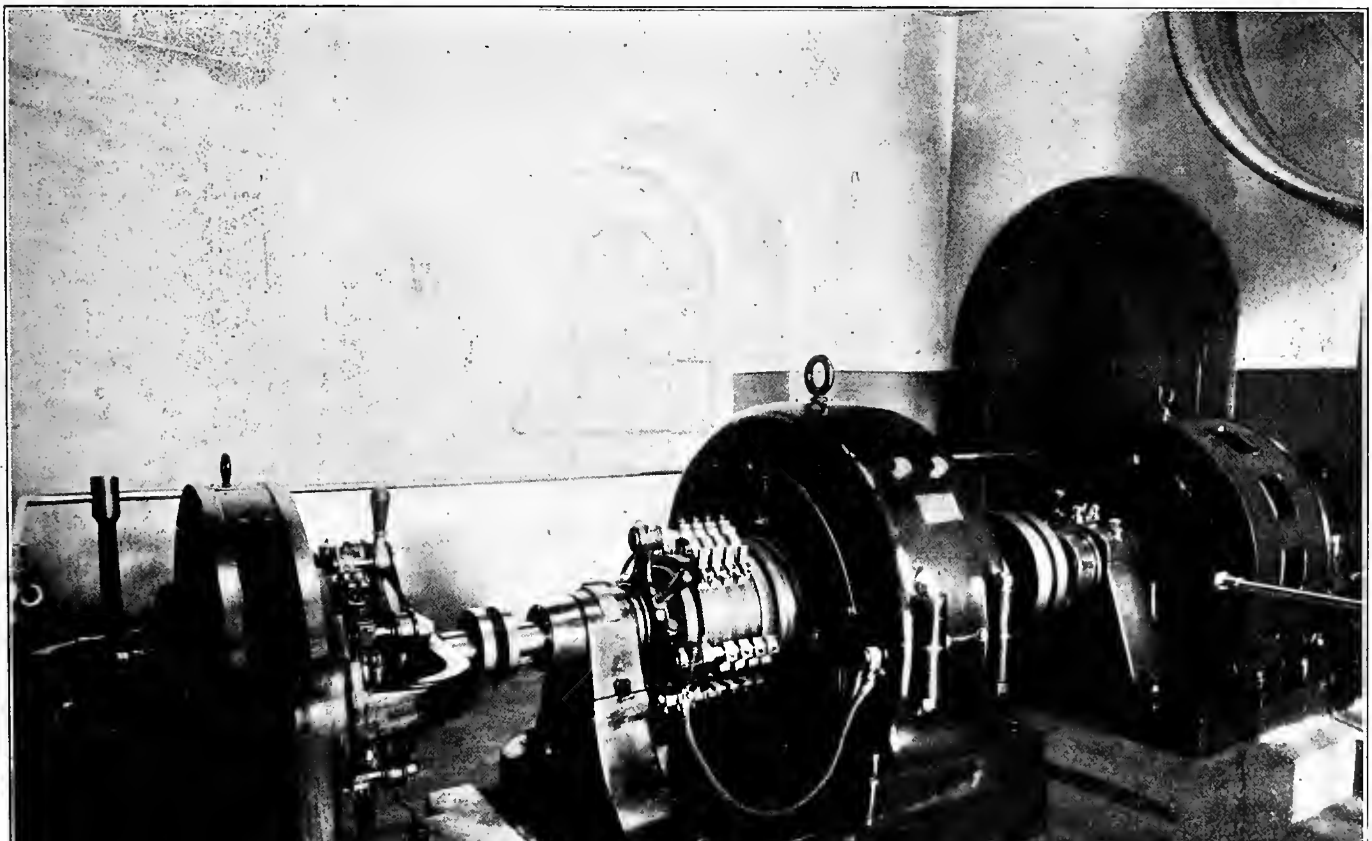

Fig. 1
MOTOR-GENERATOR SET

The storage battery installation is used largely for regulation in railway service with great satisfaction, and on account of the great fluctuations in load attending most electric mining operations, it should give a good account of itself for this work. It stores the current, which is generated as a surplus, when the load is light, yielding it again during periods when greater power is necessary.

Most of the electric mining apparatus is subject to great variations in power required, the electric pumping and ventilating machinery alone being practically constant in the power used. The electric hoisting machines for main shafts of mines are particularly aggravating in the great variations

in load thrown on and off the electric generating installation, on account of the heavy current required in starting the cage with its loaded trucks, and accelerating the speed to a maximum and at the end of the travel, the current being entirely sнut off, as the speed slackens and the cage is brought to rest at the upper landing, this being repeated at intervals of time causing serious fluctuations in the load.

The total average work done by the generating plant of a modern mine using electric power is often only 25 per cent. of the maximum load necessary at times, and the steam engines are therefore working at a disadvantage and in an extremely uneconomical manner, on account of the unsatisfactory load conditions.

The cost of fuel is therefore very much heavier than it should be considering the actual work done, and the high fuel consumption can be reduced only by storing energy during periods of light load and giving it back to the power circuits during heavy load.

At the Gewerkschaft Karlsfund mines a motor-generator buffer set has been installed, as shown in the accompanying illustration, Fig. 1, together with a buffer storage battery plant, consisting of 120 cells, each having a capacity of 648 ampere hours, 216 amperes being the charging and discharging rate.

This accumulator plant not only acts as a regulator or carrying the peak loads of the electric mining apparatus but is also used as a reserve for electric lighting service in case of emergency, and is employed for both light and power service when the steam generating plant noted in Fig. 2 is not in operation. This generating plant, as noted, is a belt driven installation, the main alternating current generator having a capacity of 100 kilowatts, with two other units of thirty-five kilowatts and fifty kilowatts capacity installed for reserve, although they could not be used to advantage. The load on the large machine was only about 30 per cent as an average, although at times the steam engine was unable to carry the load required during maximum service.

By the installation of the storage battery plant and motor generator buffer set, there was an increased economy in operating the main generator, as well as safety and reliability, for the battery provided the necessary compensation in the generator load and also gave a reserve plant for service in case of interruption of generation of current at the power plant.

The motor generator is placed in parallel with the main alternator, the storage battery plant being connected with the direct current end of the motor generator set. There is a transformer which feeds the converter mounted on the same shaft of the motor generator set as indicated in illustration, Fig. 1. It will be seen that the continuous current generated according to the series connection of the transformer with the drehstrom system, is proportional to the current strength traversing the latter and is employed for regulation by flowing through the coils in opposition to the separate excitation of the magnets at the direct current end of the motor generator.

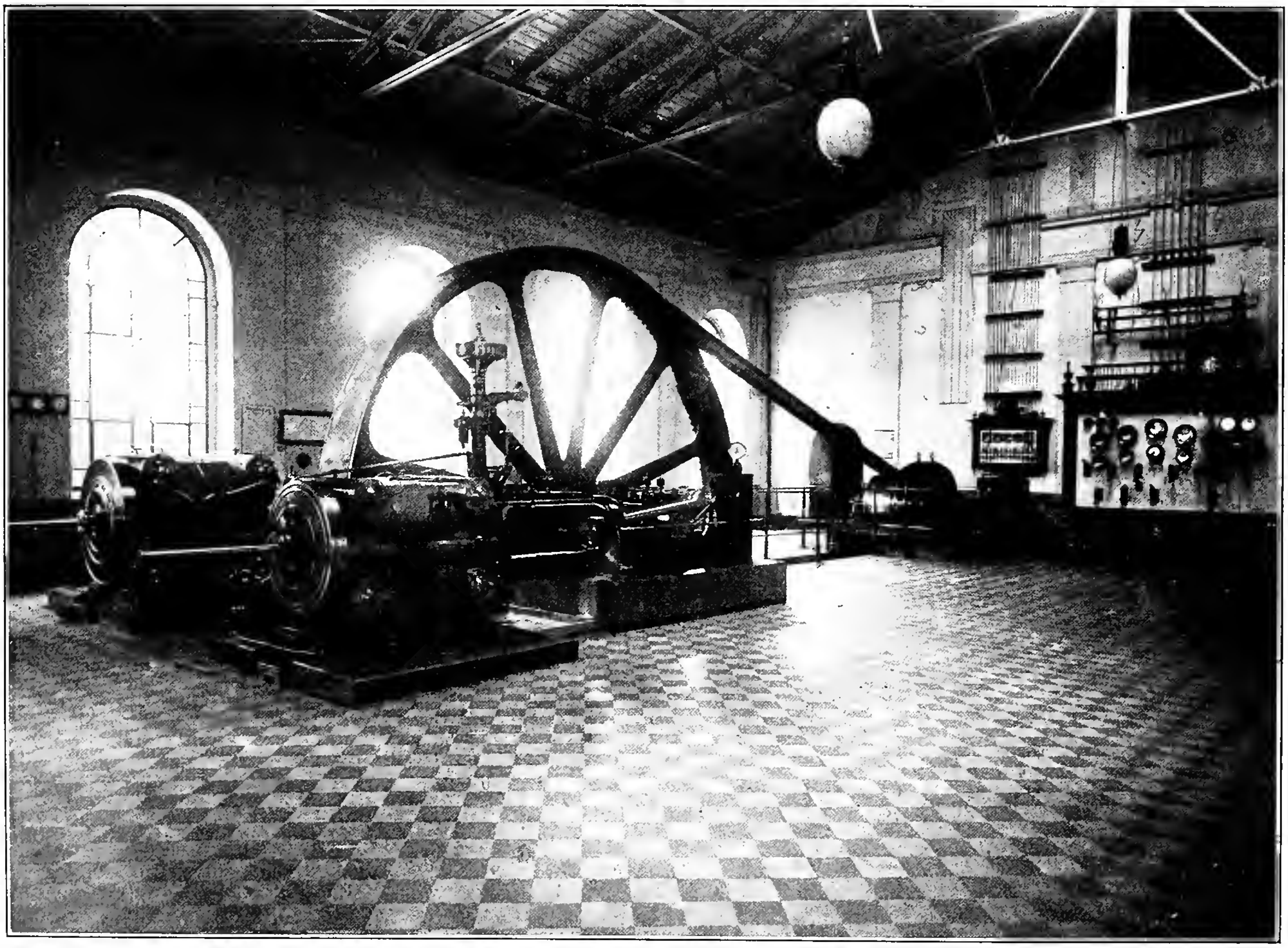

Fig. 2
STEAM ENGINE WITH 100 K. W. R. C. GENERATOR

When the drehstrom circuit has its current intensity increased, the potential is reduced so that the accumulator being discharged acts as a motor, and the drehstrom end of the motor generator set will supply a current to the rotary current circuit, while the current intensity in this circuit decreases, the tension is increased and the battery is in turn charged again.

This system is of great convenience and is most satis-

factory in operation, as it is automatic and requires for its working no complicated switching mechanism, relays or other devices liable to get out of order.

The accompanying illustration, Fig. 3, shows the switchboard employed at this electric mining equipment, which includes twenty-five arc lamps as well as about thirty motors of a total capacity of 250 horsepower, together with over 1,000 incandescent lamps, the total connected load being about 300 kilowatts.

Until this installation was made the main alternator of 100 kilowatts capacity was required day and night, with an average load of 30 per cent., but since the storage battery plant and motor generator set was placed in operation, the smaller machine of fifty kilowatts output has been able to handle the load, with power to spare, during about seventeen hours of the day, the alternating current circuit being supplied with current from the accumulator plant during the remainder of the twenty-four hours by the aid of the motor-generator-converter set.

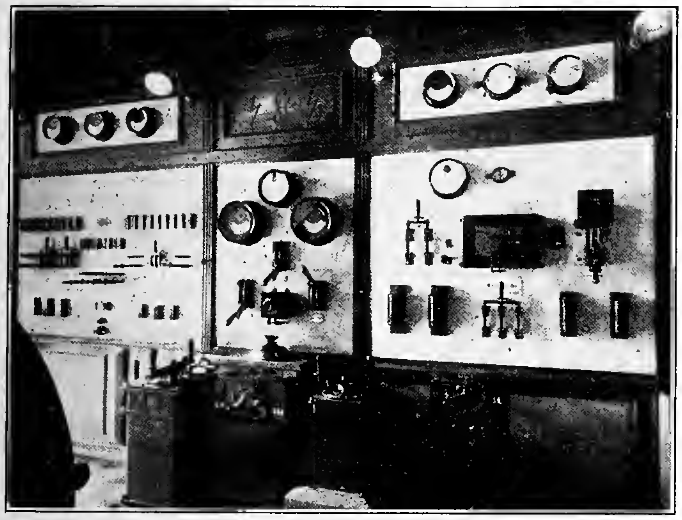

Fig. 3
SWITCHBOARD

It is stated that the potential at the bus bars of the a. c. circuit does not vary over 2 per cent., and self-recording instruments have been employed, the curves plotted showing most satisfactory results, the output of the main rotary current dynamo being kept at practically a constant output of twenty-five kilowatts, this being interrupted only by slight variations when two electric capstans were used. It is stated the cost of operation has been reduced one cent per kilowatt by this addition of the accumulator plant and motor generator set.

FOREIGN OBSERVATIONS.

The best shops, those that would best bespeak the industrial progress of the country, are closed to all visitors. Factories for automobiles, hardware, machinery, forgings, chemicals, dry goods, etc., which are freely opened to the visitor in America, are absolutely closed to every one here. There is no free, wide interchange of ideas, and with a few exceptions, the visitor is not received hospitably, and often discourteously. The methods and processes of each company are jealously guarded. Engineers entering the employ of some companies, have to sign an agreement that they will not work for another firm in the same line of work for a given term of years. If a person can procure several good letters to a particular firm, and bends every effort to visit that firm, he may succeed; but general letters and a mere formal application do very little good for the traveling man who wishes to see a great deal. A pleasant contrast to this has been the writer's experiences in and around Berlin, where shops, factories, power houses, pumping stations, etc., are opened and explained carefully to the visiting classes from the technical school. Power houses, hydraulic stations, etc., are never hard to gain admission to and many very fine equipments are to be seen all through Europe, as the frequent descriptions in the American technical papers testify, but with factories and shops, it is quite different.

In a recent trip from Berlin to Magdeburg on a motor cycle, we passed and visited many interesting places from an engineering standpoint, including water supply systems, sewage farms, potteries, canal works reclaimed land, low head turbine installations, and the magnificent roads, themselves, furnish rich material for the attention of any engineer. The water supply systems, as a rule, are driven by gas engines, and pump to stand pipes, or towers, supplying everything, from a small village enroute to the large cities. The whole country is marshy and cut up into canals, lakes or rivers, all draining, to a limited extent, into the Elbe. This water is all filtered, or aerated, before used.

The sewage farms outside of Berlin and Magdeburg are worthy of study. The sewage is pumped on to some and handled very similar to irrigation. On others it is hauled in a solid form and dumped. They smell terribly and while, obviously fertile, especially for feed or fruit, it is unpleasant to think of vegetables coming from such a place. The soil is sandy everywhere and well adapted to soaking up sewage. The reclaimed land is enclosed with huge dykes then pumped out and such land is, in some places, used for sewage farms.

The channels are everywhere deepened and widened and used for traffic. At some places are locks and low head turbine installations. One installation was running on a head of not more than two feet and developing some seventy kilowatts with very little trouble.

The roads across this marshy land (of course, there are long sections through forests, etc.) have a heavy rock foundation, then riprap, then a top of concrete or fine cobble work laid as smoothly as a floor. The writer was traveling on a motor tandem, six horsepower, with a friend, and the whole distance was made in a little over four hours, making an average road speed of thirty to thirty-five miles an hour. One straight away stretch of twenty-one kilometers was made in less than twenty minutes. It would be hard to find an American every day road that would stand this speed. Furthermore, we road comfortably at all speeds and were limited only by matters of caution, as the tandem has made over eighty miles an hour on the race track.

N. C. PERCY.

CANADIAN HYDRO-ELECTRIC DEVELOPMENTS.

A scheme is on foot to utilize the tide in the Bay of Fundy for power purposes. A company has been formed under the name of the Cove Hydro-Electric Company, and its aim is to harness the Tantramar River at a point near Sackville. It is believed that 75,000-horsepower can be developed. If the plans of the company are carried out, work will be commenced in the Spring, and the plant will be in operation next Winter. Three dams will be needed in generating the power. Each will be concrete and will be sixty feet high. In length they will be 1,000 feet. The power house will be of the same height as the dams. Its length will be 800 feet and its width 42 feet. By means of the dams a reservoir and a discharge basin will be formed, the latter having the capacity of the reservoir. Turbines placed in the dams will give the power as the reservoir and basin empty and fill. A continuous flow of water is to be assured by the cutting of a channel in a narrow neck of land between two curves in the river. The power will be transmitted to Amherst, Moncton, and to other towns, as well as to Sackville.

DESIGN OF CENTRIFUGAL PUMPS.

By E. N. Percy.

The path of a particle of water in a centrifugal pump can be laid out graphically, with a fair degree of accuracy, for a given blade. In Figure 1, we have the water entering the runner at A, and with a direction and velocity B A, with a wheel velocity of A-D, and a resultant relative velocity A-C By well-known graphical methods, the path of this water molecule, as impelled by the blade, can be plotted to the point of exit F.

Assuming that the suction stream approaches the runner, parallel to the shaft, and spreads radially into the runner, it would seem that the entrance would be in a radial direction, at right angles to the radial movement of the wheel. This may be so, or the angle of approach may incline either side of the perpendicular. For a so-called fast runner, the angle, B A D. will be obtuse, and for a slow runner, acute; because, in the figure, where is indicated a "fast" runner, it will be noted that the path of the water bends sharply at point A., in a tangential direction. This will, apparently, cause a large shock loss, and, in many designs, there is a large loss here; as no part of a centrifugal pump is quite as important, or as hard to design, as the first 30 per cent of the blades, as here, probably, occur the greatest losses. In reality, as the blades suddenly force this water in a tangential direction, the water just back of it is, in a measure, forced in much

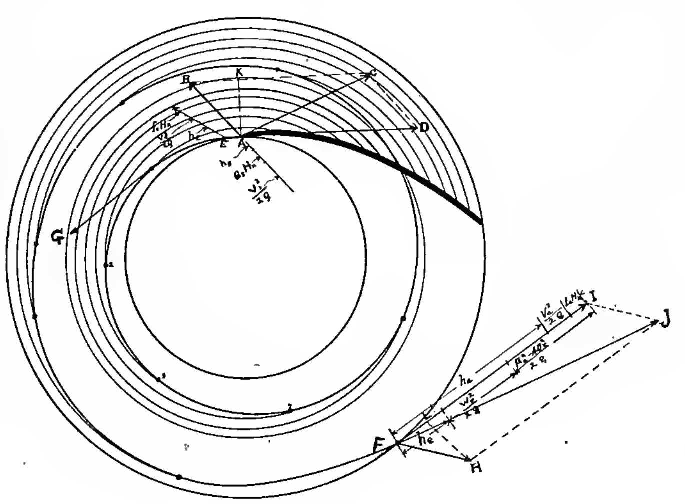

Fig. 1

the same direction by the atmospheric pressure, and velocity head; the external force, serving to effect a change of direction being merely to constant tendency of the water to follow the runner; partly through current and skin friction, but mostly from the inertia of the water expending itself in tangential velocity, because the port area of the runner, being less than the area of suction pipe, the radial velocity must increase, and in just that proportion, will the angle vary from the perpendicular to tangency.

On the other hand, if the runner be a very slow running one, so that the path of the water, radially, is comparatively rapid, and the blade have a considerable slant backwards (we will discuss blade design later), the angle B A D may be quite acute, and the path B F shorter, especially if there is an increase of suction port area, requiring a decreased velocity at the wheel entrance.

As this tangential action of the water is more or less uncertain, and as it is the source of important losses, makers have recently been putting guide vanes on the suction side of their runners, extending to the suction pipe, thus receiving the water radially, and guiding it to the runner, and delivering it at a positive angle, from which its further progress could be accurately determined. This apparatus adds about five per cent to the duty of a carefully designed pump, so far as the writer was able to determine, in some rather incomplete experiments.

We have the water now entering the runner with a velocity V from the suction opening, where it had a velocity V. Suppose in accordance with Fig. 1, that $V_s > V$ because of smaller port area. Let A K = V, then $\frac{V}{V_s} = \frac{\text{Area Port}}{\text{Area Suct. Pipe}} = \frac{AK}{X}$ A K Let A B be drawn equal to X, and touching parallel B. K. Let A. D. be tangential velocity of wheel, and complete the parallelogram, giving the resultant A C, relative to the runner. Now let B A equal total head at that point where h_a =plus or minus actual net suction head; $\frac{v_s^2}{2g}$ = net velocity head; and q_s h_n=total friction head, then

This represents the power exerted (+ or —) to bring the water to the point A. From a given blade, we plot the path of the water, with the given velocities; bearing in mind that the tangential velocity alone can vary. The radial velocity can only vary if the profile of the pump is such as to give a varying circumferential area. Taking circumferential elements from the blades, with any given unit of angular measure: the radial components can be carefully calculated according to the various governing circumferences, and plotted.

In calculating these radial components, one considers, first—the correction for entrance at an angle other than 90 degrees; second—the variations of radial velocity, due variations of radial area of cross-section, and third, the increasing head, due to centrifugal force, while not affecting the velocity, gives the series of pressures, affecting the design of the pump, especially the thickness of metal. Having the path of the water, we take the well-known formula for centrifugal force

$F = 1.2276\ W\ RN^2$

F=force; W=weight in lbs. (per second for water); R =radius and n=revolutions per second. Since the force varies as the radius, we need only take an average radius, from twenty or thirty ordinates on the curve, and the energy imparted to the water is easily calculated.

The water leaves the runner, of course, in accordance with the laws of centrifugal force, in a tangential direction. The length of F I can be found as follows: The radial component L H is unchanged, and therefore equal to A K, provided the wheel profile gives an unchanged section radially, to the water, and F. H is taken, again equal to A B; F I and H J extend indefinitely, parallel to each other. Before we can establish resultant F J, which is absolutely necessary for the design of guide or diffusion vans, we must have a correct value for F I. This must be built up. It could be plotted directly, by assuming the energy imported by the centrifugal force, expressed as velocity in a tangential direction; but this does not segregate certain quantities, which will be needed for later wirk. The velocity, tangentially, cannot exceed the velocity of the runner, and is equal to it, this gives a head $\frac{v_a^2}{2g}$. In addition, we have the friction head, f_a H_n, and the discharge head ha; the total of which, give the pump discharge head, F I. Now to obtain this head, we have had $\pm H_a$, the suction head pressure, to begin with; F I—A D, or the head imparted by the wheel; and $\frac{W_a^2}{2g}$ or the velocity head. Thus, we have $N_a + \frac{v_a^2}{2g} + f_a H_n = N_e \frac{W_e^2}{2g} + \frac{FI-AD}{2g}$ giving in a clear form the relations between suction and discharge equations. Now let us change the value F. I. absolutely. Giving it only the value Va, or exit tangential velocity. Then have we our

resultant, F J, and from it the real direction and velocity of the water. Guide vanes, or diffusion vans, must have the beginning of their lead, parallel to F J Their further development will be treated later.

From the equation, let H=total head, or $H = h_a + \frac{v_a^2}{2g} + f H_n$. And as we know V and $f H_n$ (friction losses) are a matter of experience and judgment, h_a indicates to us the head, or pressure under which the pump is capable of working at a given speed. Of course, all of these diagrams can be analyzed to any extent by trigonometry and calculus; but that is unnecessary in a mere outline of method. In regard to what pumps actually do, it is hard to say, as so far as lift is concerned, one factor alone is affected, that is, the peripheral speed of the runner, and no manufacturer will give this. From personal and authenticated tests, the writer quotes following results:

500 ft. per min, raises water 1 ft. without discharge
1000 ft. per min. raises water 4 ft. without discharge
2000 ft. per min. raises water 16 ft. without discharge.
4000 ft. per min. raises water 64 ft. without discharge

Kent gives an empirical formula, that is very good, for quick approximations, since it is taken from actual tests:

$500 + 500\sqrt{H}$ = peripheral speed in feet per minute.

The efficiencies of commercial stock single stage pumps of good manufacture, running within thirty feet of the lift for which they are designed, will run from 50 per cent to 60 per cent. A test of such pumps, reported in Trans. A. S. M. E. IX., 237, and the tests, absolutely verified ran as follows:

Andrews, 3 pumps, ...46.52 % 53.00 % 57.57 %.
Heald & Sisco, 3 pumps 64.50 % 60.74 % 55.72 %.
Berlin, Schwartzkopff, one pump, 73,1 per cent.

High duty pumps are made as high as 85 per cent efficiency; and in Germany, makers will write guarantees for 88 per cent, and 91 per cent has been obtained.

Figure 2 shows a pump with which the writer was familiar, and is very characteristic of the better class of commercial pumps.

No problem, in regard to the centrifugal pump, is more puzzling than to know how many blades to give it. It is a matter in which there is a comparatively wide range, without materially affecting the efficiency of the pump. In ordinary pumps, not of very special design, the number of blades can run from six to fourteen or sixteen blades. The guide blades are usually about 20 per cent less in number. No mathematical construction will give an exact, preferable number of blades. If one has too large a number, shock and friction losses increase, the area of flow is too much reduced, and the runner becomes costly and heavy. If too few blades are used, the water is not well guided, it leaves the path more or less, to swirl and eddy, and the relation between entrance and exit calculations is partially destroyed. In general, high speed runners have fewer blades, and slow runners have more. Runners having blades bent forward, instead of back, and, consequently, delivering the water at a high tangential velocity and comparatively low radial velocity, must have as high as twelve to sixteen blades to preserve this relation; while recent, so-called "Kreisel" pumps, made in Germany, driven by steam turbines and running upwards of 20,000 (twenty thousand) revolutions per minute, have only three blades, and show a very good efficiency; but the friction losses are abnormally high. In general, it may be said that after the form of a blade is established for a given set of conditions, the entrance end of a blade should be approximately between the center point of pump and tip of exit end of next blade in front, making a point to choose one more blade rather than one less to fulfill this condition. In other words, it should not be possible to draw a radius that will not cut a blade.

One the other hand, twice this number of blades can be used to advantage in many high duty pumps; and in addition, half blades are often used between the main blades, extending from about half way in the runner to the periphery.

The calculations will always show the limits or extremes in number of blade, because of reduced port area, long extremely narrow passages, or large bodies of water that are obviously too far from influence of insufficient number of blades. Hence, by the time all other calculations are finished, the number of blades is known from the conditions existing.

Returning to Figure 1, the radial velocity L H cannot vary, under the supposition that the port area is constant, but while $\frac{v_a^2}{2g} + h_a + f_a H_n$ = a constant for the same number of revolutions, $\frac{v_a^2}{2g}$ and H_a will vary with different forms of blades, although their sum is constant. As the outer tip of the blade is bent forward, $\frac{v_a^2}{2g}$ increases, and h_a decreases. This affects nothing but the design of the guide apparatus; but if the pump be without guide apparatus, then must it be so designed as to have the greatest possible tangential effect, as F. I, and the smallest possible component, F H, as the latter involves a shock loss. This is accomplished by varying the radial port era of runner, giving the blade the greatest angle the diagram will allow, and constructing casing as a guide apparatus. Having established the blade angles of entrance and exit, we have only to remember that its work is to bring the water gradually into circular,

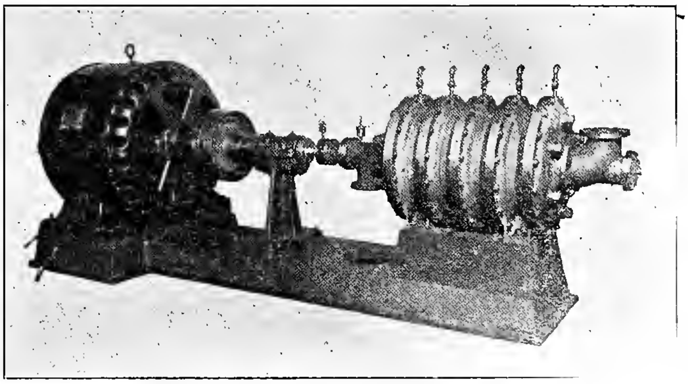

Fig. 2

CENTRIFUGAL PUMPS DIRECT CONNECTED TO ELECTRIC MOTOR

or more correctly, spiral movement, and again gradually bring it to the discharge, without a parting swirl from the blade tip. Therefore, the blade tips should be some gradually increasing curve, as a parabola, or involute, while the belly of the curve should be comparatively flat (not an arc), as its work is tangential, and the water should not be unnecessarily guided or turned, after having once been brought to the full spiral movement; as a matter of fact, this is done in all German designs.

Taking the entrance ends of successive blades, as in Figure 4, let us investigate the shock losses here. If the number of blades is "n," then $a = \frac{A}{n}$ and a stream of water of width "a," will approach the blades. Owing to the thickness of the blade, this area must suddenly be reduced from width a to width b, causing a shock loss. This loss is lessened by making the dip of the blades as thin as possible, and pointed, thus reducing the shock to a more gradual process. Again must the stream suffer a shock loss by increasing its velocity suddenly in the ratio $\frac{b}{c}$ because the projection of the blades offers a larger area than a section at right angles,

as through c. This is overcome absolutely by carefully aligning the blade to suit the flow of water according to the entrance diagram, and bending the blade tips to guide the flow gradually to greater velocities, if necessary.

Where we have blade tips cutting past guide or diffusion vanes, whether on suction or discharge, there may be serious losses. Take an arrangement as in Figure 5. The water flowing through d, must suddenly alter its velocity to suit h,

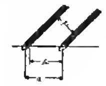

Fig. 3

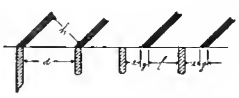

Fig. 4

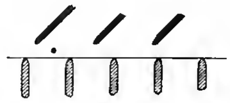

Fig. 5

and as the wheel moves to next position, the exit area of d is reduced by the amount g, in addition to the reduction due to D, the available area being only e + f, or d — g Furthermore, where guides and blades run so close to each other, any small object in the water is almost sure to wreck the pump. This also gives rise to constant shock losses from the water striking g. Therefore, it is advisable to separate the wheel and guide blades by several inches, to carefully point both, and to have dissimilar numbers of each, as shown in Figure 5.

The wheel profile is a matter to be carefully judged. It is best to design, or at least calculated with a uniform radial velocity; then can the profile be so varied as to give the radial component of the exit velocity any desired value, within the possibilities of the wheel.

The analysis of details of centrifugal pump will be taken up one by one, later. The writer has no wish to claim any of this as original, but as a compilation from standard authorities, and from pamphlets issued by various investigators and makers. After a review of analysis, will be taken up a summary of results, and discussion of types of pumps now manufactured.

THE PLAN AND SCOPE OF THE ILLUMINATING PROVISION, BUILDING OF THE ENGINEERING SOCIETIES. *

(For the following particulars of the plan and scope of the means taken for the illumination of the magnificent building of the Engineering Societies, West Thirty-ninth Street, between Fifth and Sixth Avenues, New York, we are indebted to the courtesy of Prof. F. R. Hutton.)

Complete specifications were prepared and sketches made by the consulting engineers, acting in co-operation with the architect, for the illumination of every room, and for every fixture in the building. It was realized by the engineers that the illumination was necessarily only one feature of the building and must be subordinate to, and in harmony with, the architectural features.

The central space in the entrance hall or foyer is lighted by means of individual lamps, placed in recesses, and concealed by panes of ground glass in the ceiling, at the sides of the rectangle formed by the columns around the large central area. In addition to this, larger crystal balls are provided in the outer corridor beyond the central space and in the elevator hall, entrances, etc. The effect of the individual lights in the recess, screened by glass, is to afford ample illumination without any glare.

Crystal glass balls, holding "metalized filament" lamps of various sizes, from 50 to 250 watts, are used on the principal floors, from the first to fourth, inclusive. In some cases pagoda reflectors are used inside the balls to increase the effective illumination and to reduce the current consumption. In other instances, however, in order to subdivide the number of lights in the hall fixtures, several lamps have been placed inside the crystal balls. In all such instances the metal plate at the top of the fixture supporting the sockets has been silvered to act as a reflector and to increase the efficiency as far as possible.

In the halls above the fourth floor, glass globes have been provided to screen the lamps. These globes, made according to the specifications of the electrical engineers, are unusual in the fact that the intrinsic brilliancy of the lamp is reduced without an excessive loss in the efficiency, and at the same time a warm, pleasing opal glow is produced.

The lighting of the auditorium is the most effective and probably the most interesting feature of illumination in the building The result was obtained by the complete co-operation of the electrical engineers with the architects. At the engineers' suggestion the architects provided a space of about 15 inches between the ceiling of the auditorium and beams of the floor above. At the suggestion of the engineers, also, a glass septum was substituted in place of the proposed plaster panels in the ceiling. The details were then carefully worked out as to obtaining access to the lamps for renewal, and tests were made by the engineers to find a glass that would reduce the intrinsic brilliancy or glare, and at the same time would not have an amount of absorption prohibitive on the score of economy. The result obtained has been very satisfactory, and it is possible to sit through an entire lecture without being disturbed or distracted by the lighting. The general effect is both soft and pleasing, and resembles or suggests sunlight passing through glass, as at Napoleon's Tomb in the Invalides, in Paris. As a matter of fact, the solid arches of the floor above are within 2 or 3 feet of the glass through which the light passes. Additional lighting screened by the same kind of glass is provided at the rear and at the sides under the balcony. Dimmers are provided for reducing the amount of illumination in the auditorium to any desired point, and also for the purpose of gradually increasing the lights to the maximum, after the room has been darkened for a stereopticon, thereby avoiding the unpleasant sensation produced on the retina of the eye, by flooding the room with light immediately following comparative darkness.

The lighting of the assembly and lecture rooms was also designed to prevent the lights from being distracting or unduly noticeable. For this reason, the cove method was adopted, with additional outlets in the ceiling for supplemental fixture lighting. The difficulties of the building construction, did not admit, in all cases, of obtaining continuous coves, nor coves of the exact form and dimensions desired. While the cost of lighting by this method is in excess of that using exposed lamps, the fact that the rooms are not in continuous use, but occasionally, for lecture purposes, offsets this objection.

The general illumination of the library is obtained by means of lamps placed above the glass ceiling skylight on a plan similar to that used in the auditorium, the glass in the ceiling skylights being of the same kind as that used in the auditorium ceiling. In addition, ceiling outlets are provided for general illumination, so that the indirect lighting above the glass need to be used only at certain times. The light for reading is obtained by means of standard fixtures placed upon the tables. The general effect is charming and agreeable.—

*From the American Gas Light Journal.

LIGHTING OF AN OFFICE BUILDING.*

(By Charles M. Cohn, Member.)

The chairman of the New York Section has requested a description of the lighting of the office building recently erected by the Consolidated Gas Company of Baltimore city, and although there are no features that are especially novel, these few notes have been prepared in compliance with his request.

Among the buildings erected in Baltimore shortly after the great fire of 1904 was the office of this company, whose former office building was destroyed on the first day of the fire. The site selected is a short distance beyond the limits of the burnt district, and is in the heart of the principal retail section of the city.

In the rebuilding of the burnt district, now almost completed, the company took advantage of the opportunity for the improvement of the system of house-piping, and was successful in having generally adopted by builders and architects the specifications formulated and recommended by the American Gas Light Association. The arrangement of the house-piping in the new building of the company was done in accordance with these specifications, which merely embody the ideas we advocate.

In the lighting of the offices of the company, the economy of the arrangement was carefully considered, but the matter of economy was subordinated to the broader questions of good illumination and ornamental lighting. The efficiency of the mantle burners made the matter of light absorption by suitable shades a matter of little importance. The mantle burners were used exclusively throughout the building, and the cylindrical shape of the mantles themselves aided greatly in the decorative features of the lighting.

The first floor, which is used by the public and by the office force coming directly in contact with the public, handling orders passing to and from the Distribution Department, is satisfactorily lighted by side brackets attached to the six pilasters at the sides and the three columns in the middle and side of the room. On each of the pilasters a five-arm bracket is placed, and on each of the two columns in the middle of the room four three-arm brackets, and on the column on the side of the room two three-arm brackets are used. The approximate number of square feet in this room is nineteen hundred, the height of the ceiling is fifteen feet three inches, and the lights are about nine feet above the floor. The brackets are of Flemish design, finished in brush brass, and are equipped with Enos socket burners, arranged for electric glassware. The generally recognized objections to the extended use of mantle burners—the unpleasant whiteness and glare—were overcome by the use of amber-tinted shades, sand blasted inside. It was to remove these disagreeable features that considerable effort was made to find shades that had a soft amber, yellow or pink tint, and in trying to procure shades of this character we communicated with a number of glass manufacturers and burner manufacturers, and we were told that nothing could be had at a reasonable price excepting the gaudy etched shades that are found so often in connection with cheap fixtures. It is a remarkable fact that so little progress has been made in suitable glassware for incandescent gas burners. We were, however, finally able to persuade a well-known glass concern to make up for us some special samples carrying out our ideas, and from these samples we found an amber-tinted shade so satisfactory that we at once secured a large number of them for our own use as well as for the use of our gas consumers. While we find this shade absorbs from thirty to thirty-five per cent of the light, it is very desirable and popular.

In the private offices on the upper floors of the building four and six-arm brush brass chandeliers of simple designs are used, amber-tinted shades being also used on these fixtures, some of which are equipped with Enos socket burners and others are the combination arrangement of fixture and burner known as the Enos Bunsen fixture. In addition to these chandeliers, swing brackets with Welsbach burners, fitted with Holophane Bobesches, with ten-inch opaline dome shades, are generally used for desk lighting, placed about four feet above the desk, and have been found very satisfactory in providing a soft and easy light for office work. The Bobesche shields are mantle entirely, and the white lining of the dome shades aids materially in the diffusion and distribution of the light.

The bookkeeping department and the drafting room of the Engineering Department, both being of nearly the same area as the first floor, are lighted with a number of single-mantle burners, connected with ceiling outlets, the burners having a white enameled metal chimney three inches in diameter and twelve and a half inches in height over a short clear glass chimney. They are a modification of the burner recently put on the market under the name of the "Lucas light." These lamps are finished in brass and white enamel, which form a pleasing combination, and have been found to be highly efficient, giving from thirty to thirty-five candles per cubic foot per hour of gas burned, and give a good distribution of light. They are of two hundred candle power each, and have been found, commercially, to be very satisfactory where an efficient light is desired for lighting large spaces.

Another attractive combination, which is used in the offices and in the toilet rooms, is a two-arm pendant holding a Welsbach burner with a Holophane globe fitted closely around and almost entirely covering the brass shade holder of the burner. An improvement in the shape of the globe so as to conceal as far as possible the brass shade holder was first suggested a few years ago by this company in its desire to improve the crude appearance of incandescent gas burners, especially when contrasted with the neater and more attractive appearance of electric burners. This combination is, of course, well known, and calls for no further comment.

In the planning and laying out of the piping of the building an abundance of outlets were allowed, and upon the completion of the building such of these outlets were used as were deemed necessary for good illumination. Practical experience was largely followed, with the result of an abundance of light throughout the building and a pleasing and attractive effect from the arrangement of the lighting and fixtures.

No attempt has yet been made to measure the amount of illumination at any one point, although a study of the conditions, showing the exact amounts of illumination on the desks, floors, and various parts of the room, is purposed on the first convenient opportunity.

A paper presented before the Illuminating Engineering Society, March 8, 1907.

STEEL CITY ELECTRIC COMPANY'S NEW BUILDING.

Owing to the rapid growth of the Steel City Electric Company of Pittsburg, whose plant was located at Third Street and Penn Avenue, Pittsburg has become entirely too small, and in spite of the fact that they were running night and day turn in order to keep up with the orders coming in, found it useless, as in spite of their efforts things were becoming more congested every day, but now they have moved into their large new building, which is located at 1207-19 Washington Avenue, Allegheny, which is a part of Greater Pittsburg. Their new building, which will be occupied entirely by the Steel City Electric Company, is thoroughly equipped and is a modern building for manufacturing purposes. They expect, after getting comfortably settled and in first-class running order, to be able to take care of their rapidly growing business. The specialties that this concern manufactures are the celebrated star bushings, water-tight floor boxes, universal insulator supports, beam straps, conduit reaming device, conduit benders and locknuts.

HORSEPOWER RATING OF GAS ENGINES.*

By Mr. Henry C. Hart.

That there is a wide difference in the methods employed by manufacturers in arriving at the rating of the horsepower of gas engines is evident from the varying nature of the results arrived at, as shown in the claims set up by them regarding the merits of their respective engines of practically the same type and dimensions.

There is of course no mystery about the operation of a gas engine and the calculation of the horsepower of any given engine, or of at least its maximum possible horsepower, is a very simple matter by use of the method I purpose to set out in this article.

As there is no value to the power of any engine excepting its brake horepower, so should there be no other rating than that based upon the power that can be actually delivered if the individual engine was perfect in design and construction and properly adjusted.

It will be found that there is a certain value to the fuel burned which, although it varies with the type of the engine and to some extent with the dimensions, can not in any possible manner be exceeded, and in fact can only be attained by perfection in design, workmanship and adjustment, and it seems reasonable and fair that this possesses the basis of horsepower rating.

As the perfect adjustment of an engine means that the best possible mixture of the fuel with the air is being employed, it is not necessary in arriving at a proper rating to ascertain the fuel actually burned, but merely to measure or calculate the quantity of explosive mixture used; neither is it necessary to know exactly the quantity of mixture actually drawn into the explosion chamber and burned, but to know how much should have been so drawn in and burned were the engine properly designed, constructed and adjusted.

The basis of the rating then should be the amount of brake power the engine should be capable of delivering in proportion to the quantity of explosive mixture that should pass through it in a given time.

If 2 engines of the same pattern, made by the same manufacturer, are set side by side and operated under the same conditions, they should give the same results; if they do not, then there must be a difference in the workmanship or adjustment.

If 2 engines having the same dimensions, but of different makes, are set side by side and operated under the same conditions and the results are found to be different, then the difference must be due to the design, or the workmanship or the adjustment. Therefore we may conclude that a rating based upon the calculated fuel consumption under ideal conditions is a fair and proper one, and that the manufacturer who turns out his engine perfect in design and workmanship will be able to deliver the power at which it is rated, while imperfection of design or workmanship must inevitably be shown if the rating mark can not be attained.

There is, however, another factor to be determined, and that is the number of revolutions per minute at which the rating should be calculated. In every engine there is of course a "critical" speed below which or above which the power per revolution decreases from the maximum; in any 2 engines in which the design, workmanship and adjustment are the same and perfect, this critical point must be the same, and any imperfections in either must result in a lowering of the critical speed point and consequently in the maximum power.

It is, therefore, necessary in order to calculate the rated horsepower of our engine to establish a value for this critical speed in a perfect engine of any given dimensions; this is evidently a hard proposition to solve with accuracy, but it is practically already solved by practice, as it is pretty well known what is the limit of useful speed in gas engines; useful speed, however, is by no means the same as the most economical speed, neither is the most economical speed the best speed at which to run an engine unless its power is considerably in excess of the work it has to accomplish; for as a matter of fact the decrease in the power per revolution is very slight for quite considerable variations from the critical speed point.

For example, a single cylinder, 4-cycle gasoline engine having a piston 6 inches in diameter and 6 inches stroke, and in all respects perfect in design and workmanship should have a critical speed of say 500 revolutions per minute. If this speed is increased 10 per cent or to 550 revolutions per minute, there will be a loss of power per revolution of about 3 per cent, but if the speed is increased 20 per cent or to 600 revolutions per minute, the loss of power per revolution may be as high as 10 per cent, while at 700 or 750 revolutions per minute the total brake horsepower will likely fall below what it was at the critical speed of 500 revolutions per minute.

The critical speed of small gasoline engines—that is, engines below 12 by 12 dimensions—will be found not too far from 6,000 inches of piston speed per minute, and for the sake of uniformity it would be well if this speed were used exclusively in rating the horsepower of this type of engines.

Considerable experience with brake horsepower tests of small gasoline engines allows me to speak with confidence regarding this critical speed point, and with a conviction amounting to almost certainty regarding the proper co-efficient for the maximum power value of 1 cubic inch of explosive mixture as measured by the cubic contents of the piston sweep in 4-cycle engines.

This co-efficient varies somewhat according to the dimensions of the engine.

But I find that in very small engines—say 4 by 4 or less—that it is very difficult to so adjust and time the revolutions as to get results of 4-foot pounds of work for each cubic inch of explosive mixture; a 4 by 4 engine has a piston sweep of about 50 cubic inches. Better results can be obtained from engines having larger sweep of piston principally on account of the decreasing ratio of cylinder walls to piston sweep as the dimensions increase, this increase being modified very greatly by the necessarily diminishing speed and consequent increase in time of exposure of the hot expanding gases to the cylinder walls.

It is, of course, impossible to say what the proper work co-efficient is for every variation of size of engine, but I use the following values, and I know of no instance where properly conducted brake horsepower tests have shown better results.

For piston sweep of 50 or less cubic inches, work co-efficient per cubic inch of mixture equals 4.

For piston sweep between 50 and 100 cubic inches, co-efficient equals 4.5.

Between 100 and 250, cubic inches, co-efficient equals 5.

Between 250 and 750, co-efficient equals 5.5; above 750, co-efficient equals 6.

In very large gas engines of from 500 to 1,000 and more horsepower the co-efficient probably may be as high as 6.5 or possibly under test conditions as great as 7. It will be found, however, that by applying this method of computation to statements of work done in larger gas engine tests, claims for greater results than is shown by a co-efficient of 7 are seldom or ever made.

It is not at all unusual, however, to see it claimed that some particular make of small automobile or marine gas engines will develop brake horsepower equivalent to a co-efficient of 7 or 8 or more, but such results may be depended upon as being absolutely impossible under any conditions whatever and branded as false without a moment's hesitancy.

To calculate, then, the possible brake horsepower of any 4-cycle engine, it is only necessary to multiply the piston sweep by the number of possible working strokes per minute,

*From the American Gas Light Journal.

this result by the co-efficient and divide the result by 33,000. Or let the area of the piston be represented by A. The length of Stroke by S. The number of possible explosives per minute by R, and the co-efficient by C. Then

$$\frac{A \times S \times R \times C}{33{,}000} = \text{B.H.P.}$$

or in the single cylinder 4-cycle 6x6 engine at 500 revolutions per minute.

$$\frac{28.3 \times 6 \times 250 \times 5}{33{,}000} = 6.44$$

I am not able to speak so positively regarding the proper co-efficient that should be used in calculating the brake horsepower of the so-called 2-cycle engines, but the consensus of such information as I have indicates that the co-efficient should be at least 25 per cent less for the same dimensions than that for the 4-cycle engine.

For this engine, then, the calculation for 6x6 single cylinder engine should be

$$\frac{28.3 \times 6 \times 500 \times 3.75}{33{,}000} = 9.66 \text{ B.H.P.}$$

In large gas engines of the 2-cycle type, say 500-horsepower and over, the co-efficient does not vary much from that of the 4-cycle engines, as the sources of loss can in these sizes and speeds be nearly or entirely eliminated.

In small, fast-running gasoline engines, however, the 2-cycle type, though much more powerful for the same weight and room occupied, is undoubtedly much less efficient as regards fuel economy than the 4-cycle type.

This must not be considered as a criticism of this type of engine, for in my opinion the 2-cycle type has many advantages over its older brother for very many uses.

The writing of this article was suggested to me by reading an inquiry on page 47 of the "Gas Engine" for February, 1907, in which the inquirer wants information regarding the horsepower of a 6-cylinder engine of 12-inch bore, 14-inch stroke and a speed "calculated" for 257 revolutions per minute, and also information regarding propeller dimensions. As the inquirer does not give the type of engine or any suggestion regarding the boat the engine is to be used in, you were unable to give him much satisfaction. A calculation of the power of the engine according to the formulas suggested by this article shows that his engine, if of the 4-cycle type, is entitled to be rated as 185 brake horsepower, the critical speed being 214 revolutions per minute. At 235 revolutions per minute it would probably develop about 200 brake horsepower. If the engine is of the 2-cycle type, it is, according to our formula, entitled to rate as of 278 brake horsepower at 214 revolutions per minute and should develop about 300 brake horsepower, if run at 235 revolutions per minute.

FIRE EXTINGUISHING EQUIPMENT IN GAS WORKS.

It must be admitted it is somewhat anomalous that, in the majority of gas works, but scant provision has been made for extinguishing fires. The reason for this failure to recognize and provide for a contingency liable to arise at any moment cannot readily be determined. That fires seldom occur in gas works cannot logically be offered as an argument against not being prepared to meet the contingency of a fire and be in a position to reduce the loss and disturbance of the plant to a minimum. It must, however, be conceded that the demands on the gas works superintendent's time are so constant and multitudinous that it is not to be wondered some things escape his serious consideration, and the writer, therefore, feels that for this reason he is in order in calling special attention to the subject and referring in a general way to some important points in relation thereto. That "prevention is better than cure" is generally accepted as a true axiom. The elimination, then, of fire risks in every way possible is most desirable, some of which may be mentioned as follows:

(a) The location of oil tanks in as isolated position as possible.

(b) The elimination of all furred, lathed and plastered walls.

(c) The use of inclosed electric lights in all buildings where seals may blow.

(d) The use of safety waste cans.

STEAM HEATING VERSUS CONDENSING.

There are certain conditions under which the cost of condensing apparatus would not be warranted by the gain in economy which might reasonably be expected, says the "Electric Railway Journal." It is, therefore, fortunate that electric railway and lighting companies can in many cases develop a very profitable exhaust steam heating business if their power houses are not too far from the business district of a city. There was a time when it was thought that steam could only be sent a few hundred feet without being totally condensed. Such, however, is not the case, as has been proved by a large number of successful heating installations having miles of pipes under the streets, in which it has been found the condensation is not more than 10 per cent in extreme cases. The experience of one company, which found it economical to operate a heating system in conjunction with a railway and lighting plant, was reported recently. The plant is of about 1,000 kilowatts capacity and supplies a small railway and lighting system in a city having a population of about 28,000. Exhaust steam from the engines is distributed to the business district and a small portion of the residential district through about three miles of pipe under a pressure of from one to seven pounds. In small quantities, the exhaust sells for 50 cents per thousand pounds, and on the flat rate contracts based on the radiating surface, the return is about 35 cents per thousand pounds. The total income from the heating system was sufficient to pay the entire coal bill of the plant and the cost of repairs and maintenance of the heating system, and to show a balance of about $1,200. Besides furnishing the heat, power for the electric railway and street lighting was supplied by the steam before it was sold at the rates referred to. It would be difficult to imagine such returns from a condensing plant. As a further evidence of the profit to be derived from steam heating systems, it may be stated that there are small electric plants within the Niagara distribution district which are selling electric light and power at a lower rate than the Niagara companies and are deriving large profits from the investment in the plant and heating systems. Surely no more severe test could be given an enterprise of this nature than to operate it in competition with the cheap power from Niagara Falls.

The Alturas Electric Light & Power Company, whose plant is located seven miles outside the town of Alturas, Cal., has recently undertaken substantial improvements and additions to its present equipment. A contract placed with the Allis-Chambers Company includes 300 kilowatt Allis-Chambers' water wheel type generator, and a nine kilowatt exciter, also water wheel driven. The electrical machines are of standard design, the generator being wound for 6,600 volts, three-phase, sixty-cycle, and operating at a speed of 600 revolutions per minute. The Alturas plant, although built for electric lighting service, has heretofore been steam-driven and made no use of the water power, the installation of water wheels being an addition.

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EDITORIAL.

Gas as a Motive Power

A description of the processes of manufacture of the three principal kinds of gas and the difference in the heating value of coal, water and producer gas, including the relative cost of power using these three different kinds of gas, is treated very fully in an article presented recently by Mr. W. H. Laurie, to the Canadian Society of Civil Engineers. The conclusions of the writer as regards the cost of fuel per brake horsepower are rather startling, but the data contained in the paper is very complete and, inasmuch as the use of gas for power purposes is rapidly increasing, the figures given are worthy of careful consideration. Naturally, the heat units per cubic foot of gas are of the utmost importance where power is generated using explosive-mixture engines. At the same time the cost of manufacturing the gas depends upon the kind of gas made and its composition.

Four different kinds of gas are considered as available for the generation of power, viz., illuminating or coal gas, water gas, semi-water gas, and producer gas. Of these different kinds, the illuminating gas is by far the richest or highest in heat units, containing about 600 British thermal units per cubic foot. The second in point of calorific value is water gas, which contains about 300 heat units per cubic foot. The third is semi-water gas, having 150 heat units per cubic foot. The lowest in calorific value is producer gas, which contains not more than 110 British thermal units per cubic foot.

The following table indicates the approximate percentage of the principal constituents of the four different kinds of gases:

	Illuminating.	Water	Semi-Water	Producer
Carbonic Oxide ...	5.7	.42	25	23
—|—	—Heading in 6-pt.—			—|—
Hydrogen	46.5	48	19	2
Carbonic Acid	3.1	6	6	3.6
Nitrogen	3.7	5	49	63.5
Marsh Gas	35.7	.....	..	7.4
Heat Units, approximately	600	300	150	110

The wide variation between these four kinds of gases is indicated largely by the percentage of nitrogen, which, as will be noticed, in producer gas is many times greater than that to be found in illuminating or water gas. While the nitrogen in semi-water gas is less than in producer gas, it is very much greater than in either illuminating or water gas.

To show the relative power which may be developed with these four kinds of gases, a table is given where the standard is arbitrarily fixed as 100 horsepower for semi-water gas. This table is as follows:

Producer gas of 110 B. T. U.'s....... 90 horsepower
Semi-water gas of 150 B. T. U.'s.....100 horsepower
Water gas of 300 B. T. U.'s..........112 horsepower
Coal Gas of 600 B. T. U.'s............117 horsepower

It is noticeable that producer gas is especially applicable for the generation of power when compared with the other kinds of gases considered.

In determining the relative cost of power, using gas, coal and gasoline, the conclusions as set forth in the article are extremely interesting. While it is impossible to definitely establish the cost per brake horsepower in different localities, where the cost of the raw materials may vary, yet the data given is sufficient to determine with a reasonable degree of accuracy the probable result.

Using gasoline with the assumption that one-eighth of a gallon is required per brake horsepower per hour, the cost per annum per brake horsepower is found to be $78, with gasoline costing twenty cents per gallon. With the steam engine, using coal and assuming one brake horsepower to be developed with six pounds of fuel, the annual cost per brake horsepower, with coal at $4 per ton, is given as $37.44.

Using illuminating gas in the modern gas engine, it is said a brake horsepower can be produced with from 14 to 16 cubic feet of this gas, or an aver-

age of 15 cubic feet per hour per brake horsepower. Assuming that the gas costs $1 per 1,000 cubic feet, the annual cost per brake horsepower is $46.80.

When semi-water gas is the source of power, the gas being produced from anthracite coal, gas engine builders will guarantee their engines to develop a brake horsepower for one pound of coal in the generator. If the coal so used costs $5 per ton, the annual cost per brake horsepower would be but $7.80. If semi-water gas is used, generated from gas coke, actual tests of an 80-horsepower electric plant show the fuel consumption to be .92 of a pound per brake horsepower per hour. With the cost of coke $4 per ton, the annual cost per brake horsepower would be but $5.74.

Using water gas manufactured in large plants, and engines having a capacity of over 500 horsepower, the consumption of fuel is given as .8 of a pound of bituminous coal per brake horsepower per hour, which, with a cost of $4 per ton for the coal, gives as the total cost per annum per brake horsepower, but $5. In all of the above figures it is assumed that power is required in a uniform quantity during ten hours of each day.

Assuming the above figures to be reliable, it is evident that the gas engine, with suitable gas producer, will generate power at a lower cost than any other fuel, considering only the cost of the fuel. This high efficiency, however, has only been made available within the past few years, and the reduced cost of power-using gas is due to the fact that the expense of manufacturing producer gas has been made much less than heretofore, and also on account of the important changes which have been made in the design and construction of the gas engines, particularly in large sizes. Much higher compression in engines of modern manufacture is used, and also gas is distributed at high pressure, thereby reducing the cost of necessary distributing mains, particularly where the fuel is delivered long distances from the generating plant.

The gas engine, when first introduced, received little serious consideration at the hands of engineers. This was probably due to the fact that the engine as a machine for the conversion of heat energy into mechanical energy had not as yet been mechanically perfected, but also primarily due to the fact that only illuminating or coal gas was available.

In the earlier forms of gas engines the fluctuation of speed during each revolution was so great as to prohibit their use for driving electrical generators. This difficulty has been largely overcome, and if the figures set forth by Mr. Laurie are to be depended upon, electrical power can be more cheaply produced through the use of gas engines than by using steam engines. Certainly, if lighting is the result desired, it is cheaper to use the gas as a source of power in gas engines, which are used to drive electrical generators to produce current for lighting, than to use the gas direct as a form of illuminant.

BOOK REVIEW.

United States Department of Agriculture, office of Experiment Stations, Irrigation and Drainage Investigations, announce the publication of Bulletin 183, Mechanical Tests of Pumping Plants Used for Rice Irrigation in Louisiana and Texas, 1905 and 1906, by Prof. W. B. Gregory, Tulane University of Louisiana.

This report gives the details of a large number of mechanical tests of pumping plants used for rice irrigation in Louisiana and Texas. Most of these plants use crude oil for fuel, and they are therefore of special interest to those using this fuel.

The bulletin also includes estimates of the cost of different types of plants and their cost of operation, showing that in most instances the high-class machinery is very little, if any, more expensive in first cost and very much cheaper in operation.

Applications for this bulletin should be made to the Director of the Office of Experiment Stations, Washington, D. C.

TRADE CATALOGUES.

General Electric Co.—"Electric Pumping Plants" is the title of Bulletin No. 4496, in which descriptions of two typical pumping installations of this type are given.

A beautifully illustrated and artistic brochure on General Electric Fan Motors, for 1907, has also just been issued.

Bulletin No. 4393-C contains subject-matter pertaining to small moderate-speed, engine-driven, revolving-field alternators.

REMOVAL NOTICE.

Oakland, Cal., April 19, 1907.

Journal of Electricity, Power and Gas,

Atlas Building, San Francisco, Cal.—

Gentlemen:—The General Electric Company have vacated the offices occupied by them for the past year in the Union Savings Bank Building, Oakland, and will take possession of its permanent offices on the tenth floor of the Union Trust Building, San Francisco, at which place the executive office of the company for the Coast will be located in the future.

The California Promotion Committee have just issued a topographical map of California. This map, in addition to showing all the railroad, steamship and oil pipe lines, etc., will contain statistics regarding the different cities and towns throughout California, with their population, and also much valuable information regarding mines and minerals, agriculture and horticulture. It will be correct in every detail and has been amended to date.

This publication is one of value and ought to be in the possession of everybody interested in the welfare of the State. The prices at which it can be obtained are given below.

Single copy in tube, ready for mailing, postage paid, 10 cents. In lots of 100 maps only, postage extra, 7 cents each. Single map, in redwood frame with glass, complete, ready for hanging (not crated) F. O. B. San Francisco, $1.00. Single map, framed complete, in crate, ready for shipping, F. O. B. San Francisco, $1.75. Set of five, framed complete, ready for hanging, and in one crate, F. O. B. San Francisco, $1.25 each. To induce the sale of the maps, framed, in lots of five, we will send the five for $6.25, and one extra framed complete, as a present for selling the five, all in one crate.

DEATH OF GENERAL EUGENE GRIFFIN.

Brigadier General Eugene Griffin, First Vice President and General Sales Manager of the General Electric Company, died very suddenly of apoplexy at Schenectady, N. Y., on the evening of April 10th. With his wife and daughter, he had come to Schenectady to witness an amateur play given by a local club, of which his son Hancock Griffin was a leading member.

Following the performance, while at an informal supper with a few friends, the General collapsed, expiring about an hour later.

This sudden death of General Griffin removes from the electrical world, as well as from military and social circles, a man of broad and keen intellectual interests. Trained as a military engineer at West Point, and serving as such with honor, he entered the business world as Second Vice President of the Thomson Houston Company. Upon the consolidation of this company with the Edison Electric Company, forming the General Electric Company, General Griffin became the First Vice President of the General Electric Company, holding this office until his death.

General Griffin was born at Ellsworth, Maine, on October 13th, 1855. After finishing a preparatory school education he entered West Point and graduated in 1875 with high honors.

On leaving the Academy he entered the Engineering Corps, the highest branch in the army service, serving as a second lieutenant, first lieutenant and later as captain. From 1883 to 1885 he was a Professor of Civil and Military Engineering and the Art of War at the Academy. From then until late in 1886 Captain Griffin was aid-de-camp on the staff of Major General Winfield Scott Hancock, and until the close of the year 1888 he was Chief of the Engineering Division of the Atlantic and the Department of the East. In 1889 he resigned from the army to take up electrical engineering work.

Upon laving the army Captain Griffin entered the service of the Thomson Houston Electric Company as Second Vice President. This position he held until 1891 when the Thomson Houston Company was consolidated with the General Electric Company. He was then elected to the office of First Vice President of the General Electric Company. In 1893 he was elected to the position of President of the Thomson Houston International Electric Company. He was also a director of the British Thomson Houston Company and the Campagnie Francais pour l'Exploitation de Procedes Thomson-Houston, Paris.

At the outbreak of the Spanish-American war, Captain Griffin offered his services to the United States Government. On word from Washington he organized the First Regiment U. S. Volunteer Engineers, of which he became Colonel This regiment was mustered into service in the spring of 1898. The following year, in January, he was promoted to the rank of Brigadier General. This title he held at the close of the war.

General Griffin was prominent in club life, being a member of the Union, Racquet and Tennis, University, Engineers' Ardsley Riding, and City Midday Clubs of New York City. He was also a member of the Metropolitan at Washington, the Somerset at Boston, and the Mohawk and Mohawk Golf Clubs of Schenectady and the City Liberal Club of London.

In engineering and army clubs General Griffin held membership in the following: Military Order of Foreign Wars, United States Military Academy Alumni, New England Society, Society of Naval Architects and Marine Engineers, Order of Spanish-American War Veterans, the Pilgrims of the United States, The Institution of Civil Engineering, Great Britain, and the American Societies of Electrical and Mechanical Engineers.

The funeral services of General Griffin were read at the Church of Transfiguration in New York City, a brief service having been held at the Mohawk Club in Schenectady on April 12th. The final portion of the burial services were conducted by Dr. Goodwin, who officiated at his marriage twenty-eight years ago. After the services at the church the body was taken to West Point where interment was made with full military honors. Colonel Scott, the present Superintendent of the Post, was a classmate of General Griffin's, and a full corps of cadets acted as an escort at the burial. All flags at West Point were half masted. As the procession left the chapel eleven minute guns were fired and after the salute at the grave a second salute of eleven guns was given.

The pallbearers were: C. A. Coffin, President General Electric Company; Colonel H. L. Scott, Superintendent West Point Military Academy; Hinsdale Parsons, Schenectady; B. E. Sunny, Chicago; Colonel H. F. Hodges, Major of Engineers, Washington; H. R. Bishop of New York, S. M. Hamill of Schenectady, and Dr. Louis Seaman of New York.

General Griffin was married in 1879 to Miss Allie Hancock, niece of General Winfield Scott Hancock. He is survived by his widow and two children, Priscilla Griffin and Hancock Griffin.

INDUSTRIAL

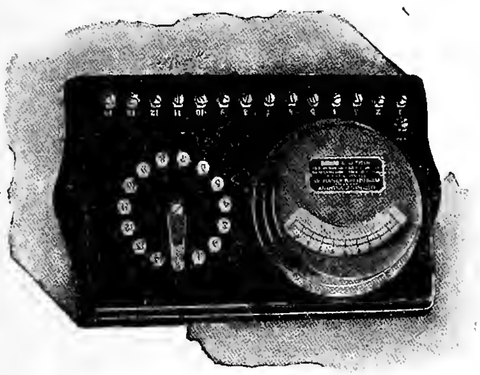
WESTON ELECTROPLATERS' VOLTMETER.

(Model 131.)

The importance of a reliable voltmeter in a plating establishment can hardly be exaggerated, as the amount of current consumed in a bath is governed by the quantity of work being done, and the current flow of course is dependent upon the voltage. Too much current (i. e., too high a voltage) results in burned work, while too little current (i.e., too low a voltage) results in a thin deposit, which comes off under the buffing wheel and necessitates replating.

An expert can readily detect the first difficulty early in the process, but the latter can only be determined by testing the work on a buff after it has been allowed to remain in the bath the usual length of time. The results being purely a matter of guesswork based upon the experience of the operator, it will readily be observed that the chances are greatly against running the plant at its maximum efficiency. In other words, it may be assumed that even if the results are generally satisfactory, it is quite probable that too much time has been consumed in the plating, or that the deposit is either above or below the desired thickness, and is not uniform on various classes of work.

With the aid of a voltmeter all guessing is eliminated and it becomes possible to operate any bath at its maximum efficiency, thus increasing the profit or reputation of the plater.



Owing to the apparently high first cost of furnishing each tank with a reliable and accurate voltmeter, platers have hesitated to properly equip their plants, and have used cheap, unreliable instruments, or have done without instruments of any kind. This is really very poor economy, as even an expensive instrument will soon pay for itself by increasing the quality and quantity of the output.

Realizing the importance of first cost from the plater's standpoint the Weston Electrical Instrument Company has designed a voltmeter specially adapted to this work, which obviates the necessity of having an instrument for each tank and enables the plater to avail himself of an extremely accurate and reliable instrument at a very low cost.

The instrument consists of an accurately calibrated Weston voltmeter, contained in an air-tight, waterproof case (which adequately protects the internal mechanism from the action of fumes usually present in the plating room), mounted on a small wooden switchboard containing fifteen binding posts and a fourteen-point switch. One of the binding posts, marked plus, is to be attached to the positive side of the plating generator or line, while the remainder are to be attached one each to the cathode side of each tank.

After the connections are made the voltmeter is thrown in circuit with any desired tank by turning the switch handle to the numbered point corresponding to the tank it is desired to test.

The instrument is designed to accommodate fourteen tanks, which is considered the maximum that can be conveniently operated from one point. Any lesser number of tanks may be connected in circuit, however, as each binding post is entirely independent.

THE ILLUMINATING ENGINEER.

As is now well recognized, the correct design of illumination for any given area is based on fundamental mathematical laws. The correct application of these laws, however, requires long experience, careful calculations, good judgment and a fine sense of the artistic. While it is generally best to take up any engineering problem directly on the ground, it is nevertheless possible, in most cases, to correctly design the illumination for any given area by a study of the plans and elevations of the building or room.

As an example of what it is possible to do by careful design may be mentioned one large public building recently completed. This building was originally designed for the equivalent of 20,000 sixteen candle power lamps. Although the outlets were not placed so as to get the maximum results, nevertheless by careful study of conditions, correct design of fixtures for illuminating as well as artistic effect, and the selection of the right glassware for each place, the load has been reduced to the equivalent of 15,000 eight candle power lamps, resulting in a saving of over $25,000 annually.

By the selection of scientifically constructed glassware, it is possible to obtain perfect diffusion and at the same time direct the maximum amount of light in the desired direction. This is one of the strongest features of the well-known Holophane System of Illumination.

In communicating with any of the Engineering Departments now being maintained by most up-to-date companies in this field, it is advisable to send drawings or blue-prints of the buildings to be illuminated, giving, if possible, the location of furniture, the uses to which each room will be put, color scheme, etc.

It is often possible to get good results in a number of different ways, thus affording rather a wide latitude in the matter of preference as to what method of illumination is wanted, such as ceiling lighting, bracket lighting, etc.

The Holophane Company has been a pioneer in the movement toward better illumination and has established an Engineering Department whose force is composed of some of the best known Illuminating Engineers. A large number of extremely efficient and artistic installations show the commendable results of the expert efforts of this staff, whose services are offered to those interested free of charge, whether or not it is desired to use the Holophane System of Illumination.

ELECTRICITY AT JAMESTOWN.

Electric power for the approaching exposition at Jamestown, like that at the Buffalo Pan-American fair, will come from a distance. Having no Niagara to rely upon, however, power for the Jamestown Exposition will be furnished by steam turbines located in the power house of the Norfolk Railway & Light Company, about seven miles from the Exposition grounds. This fair will be the first at which the electric power will be generated by steam turbines. The machines will be of the Curtis type, these as well as the complete electrical equipment being supplied by the General Electric Company.

The Exposition authorities have entered into a contract with the Norfolk Railway & Light Company to furnish all the electricity required for illumination and power purposes. The electricity generated at their Jamestown power house will be transmitted on specially constructed lines to a model substation in Machinery Hall. Here will be located the transforming and distributing apparatus. This equipment consists of large air-cooled transformers, many smaller type H transformers for general illumination, as well as constant current transformers for the series-arc lighting system which will be used for police illumination. At the substation also are motor generator sets to provide direct current for the operation of searchlights and small motors, where they may be installed by exhibitors.

The switchboard for controlling the various circuits throughout the Exposition grounds is located in a gallery and is typical of modern switchboard engineering. All the electrical machinery follows standard lines similar to that installed at the St. Louis, the Pan-American and other American expositions.

Those who have seen the plans for the Jamestown Exposition, predict that the electrical features, particularly the illumination, will equal if not excel the display at the famous Pan-American Exposition. Thousands of Edison lamps will be supplemented by searchlights both on land and on the fleets anchored in Hampton Roads, combining to make the nightly pageant magnificent and beautiful.

FOR YOUNG ENGINEERS.

The following rules for the guidance of young electrical engineers are said by Mr. H. Gilliam, in the "Electric Journal," to have had very good results:

1. Don't tell everything you know the first day you arrive to install apparatus. You may want to carry on a conversation the other days you are on the job.

2. Don't promise things that are not in the contract. The factory has a way of turning down such promises which makes you feel badly.

3. Don't think you know it all just because you are from a big company. There are a few smart men not working for your company.

4. Don't write letters to the local company; the factory has men who are paid to do this work of writing letters.

5. Don't say any more than you have to. By keeping your mouth shut you are likely to get the reputation of being a smart fellow.

6. Don't think because a man has worked all his life for a local company and you have just arrived, that he cannot give you a pointer or so. The dumbest people sometimes know a thing or two.

7. Don't take any one's word for everything being all right, but see for yourself. Trouble has a way of developing when least expected.

8. Don't forget what company you are working for, although the superintendent for the local company may say that the man before you would do "so and so." If you do not stick to the contract your company may have a man who can fill your place.

9. Don't forget that all of us make mistakes sometimes. It does not follow from this that you must make mistakes all the time.

10. Don't think that just because you have had the students' course you know more than the old road men. Some of the old road men have forgotten more than you ever knew.

11. Don't forget that the officials of your company have their eyes on you. Sometimes a position opens up and if you had worked hard you might have gotten it.

12. Don't think when you come in from a job that you are expected to hold the office furniture down. If no work is at hand look up some. Get busy.

ELECTROLYSIS IN ARMORED CONCRETE.

One of the strongest recommendations for the use of armored concrete, and for the use of concrete as a protective envelope for structural steel in tall buildings, is the fact, or the belief, that concrete effectually prevents the corrosion of the imbedded material. As far as we are aware, nothing has transpired where concrete has been used for structural or protective purposes under normal conditions, to shake this confidence.

The question has recently been raised, or rather revived, as to whether, under certain conditions, the steel of reinforced concrete may not be subject to the destructive effects of electrolysis. The revival of interest is due to some experiments recently made by A. A. Knudson of New York, and reported a few weeks ago to the American Institute of Electrical Engineers. The experiments were carried out as follows: Some blocks of one-to-one Portland cement sand concrete were molded in a common metal water pail, with a piece of 2-inch wrought iron pipe placed vertically within the blocks to a depth of about 8 inches. When the blocks were three years old, one of them was placed in a tank of sea water, and another in a tank of fresh water, and direct current was fed to the iron pipes in the center of each block, the negative electrode consisting of a piece of sheet iron placed in the tank. A third block, similar to the other two, was placed in a tank of sea water but was not subjected to the electric current. After a period of thirty days the last-named block was found to be in perfect condition and the imbedded pipe was perfectly bright. But the two other blocks, which had developed cracks during the test, were easily broken open; yellowish deposits were found in the cracks, where the concrete had deteriorated to such a degree that it could be cut easily with a knife; and the pipes were considerably corroded, showing a loss of weight of over 2 per cent. Similar results were obtained in tests with blocks of standard Rosendale cement, made in the same mold, although in this case the blocks were tested thirty days after they had been made. The cracking of the concrete appeared as early as the sixth day of the test, and by the eighteenth day they looked as though they might fall apart. One of the pipes showed a corrosion similar to the pitting action of underground electrolysis, a hole 3/8 by 1 inch being formed through the wall of the pipe.

It cannot be denied that these results are of profound

significance. They call for careful investigation on the part of concrete engineers, and the provision of special means of insulation in all cases where imbedded structural steel, or the reinforcing material of armored concrete, is liable to attack by stray currents in the neighborhood of wet foundations. The whole subject of electrolysis which, because of the exaggerated use to which it has been put by a sensational press, has not received from technical men the attention which it deserves, should be made the subject of a searching investigation with a view to determining the laws and limits of this form of corrosion.—Scientific American.

ALLIS-CHALMERS ELECTRIC MOTOR DRIVE FOR AN ALASKAN GOLD DREDGE.

The Bonanza Basin Gold Dredging Company, which has been operating during the past years in the Bonanza Basin district of Alaska, with steam driven gold dredges of Allis-Chalmers and other designs, recently made arrangements for obtaining a supply of electric current from the Dawson Electric Light & Power Company, of Dawson City.

In order to take advantage of the electric power which is now available, the Dredging Company has ordered the alteration of the big Allis-Chalmers dredge, which is the "sluice type," steam driven, to the "Stacker type," electrically driven.

This alteration necessitated the use of separate motors for each specific drive throughout the dredge, in addition to the substitution of new winches and gravel handling devices required by the change from sluice to stacker type. The current to be used will be alternating, three-phase, sixty-cycle, 2,300 volts.

The motor equipment will be made up of Allis-Chalmers standard induction motors, as follows: The bucket drive motor will be 100 horsepower, 2,300 volts, for variable speed and reversing. A fifty horsepower constant speed, 2,300 volt motor will drive twelve-inch pump. Two variable speed thirty horsepower, 440 volt machines will drive the main and ladder winches. A fifteen horsepower constant speed, 440 volt motor, operating at a speed of 1,130 revolutions per minute, will operate the screen and stacker hoist. The stacker will be driven by means of a constant speed motor, fifteen horsepower, 440 volt. A three inch primer pump will be driven from a ten horsepower constant speed machine.

The stacker for this dredge will have eighty-feet centers and a belt thirty inches wide, driven from the top end by a motor.

This dredge has already established for itself a rather unique record. One of the strangest "clean-ups" in the history of mining is reported to have been made from it, after a part of its run last summer in the sloughs of the Bonanza Basin. When the sluice box was opened preparatory to the periodical clean-up, after quite an extended period of operation, it was found that the bed of the slough, which had just been worked, had yielded an assortment of stuff, the equal of which, according to the papers of Dawson City, had never been seen before in the mining regions of the West. The collection disclosed among other things two Russian bronze ikons, or sacred figures, which had probably been carried into the region by Russian explorers many years before the Klondyke was heard of. These ikons were identical with those carried by some of the regiments of the Czar's armies in the late Japanese war. In addition to the ikons were found eight American pennies, probably thrown into the slough by some prospector in a fit of disgust, when he realized that they possessed no purchasing power in the Yukon district. There were also recovered about 100 pounds of unexploded cartridges; gallons of bullets, many of which had a coating of amalgam, which necessitated their treatment for the gold adhering; 120 pounds of nails of all sizes; an alarm clock; a saw set; two massive gold charms; an opal with its setting from a broken scarf pin; innumerable pieces of watch chains; knives, forks, keys, lock, native bismuth, etc.

During the season many large clean-ups were made, the gold was coarse and nuggets worth from $10 to $20 apiece were recovered.

LIVE WIRE DANGERS.

The British Chamber of Commerce, Genoa, has supplied the Manchester Chamber with particulars, prepared by the Association of Italian Manufacturers, Milan, of an international competition for the best scheme for the prevention of accidents from contact with live wires. The great extent to which electricity is used as the driving power in mills and works in the North of Italy compels the interest of Italian manufacturers in this subject. In the syllabus of the requirements it is stated that the invention must eliminate the danger of a contact (of whatever resistance) between the primary and secondary circuit of alternate current transformers and their respective lines. The apparatus must be simple, robust, economical and adaptable to existing installations. It must come promptly into action whenever the potential to earth of the low-pressure circuit reaches the double of the normal value in a three-phase and a two-and-a-half times the normal value in a single-phase system, and it must prevent the excess of potential becoming parmanent. The apparatus must not put the transformer out of action in the event of atmospheric discharges or of such partial reduction of insulation of service lines to earth as may be tolerated in practice.

San Francisco, Cal.—While waiting for the charter which will make their proposed union a reality the telephone girls of this city have been granted an increase of wages. The Pacific States Telephone Company, which does not like the union idea, announces that the new schedule went into effect April 1. This was a surprise to the girls, but apparently the sentiment in favor of organization is as strong as ever. The company does not admit that the increase was granted in the hope of shutting off the union. There was a report current in the union that some of the operators had been offered substantial increases if they would refuse to join the union. The girls are unanimously opposed to the acceptance of such terms. On the arrival of the promised charter, which is expected in a few days, permanent organization will be effected.

NEWS NOTES

ELECTRIC RAILWAYS.

Portland, Ore.—Preparations are being made to double track the Mount Scott railway.

Puyalup, Wash.—The Tacoma Railway & Power Co. is rushing construction of the electric line between this place and Tacoma.

Sumas, Wash.—It is reported that the survey for the electric line between here and Vancouver will be commenced at once.

Bellingham, Wash.—The Whatcom County Railway & Light Co. will lay new 60-lb. rails on Elk Street, Holly and Prospect Streets.

Montesano, Wash.—It is reported that the Grays Harbor Electric Co. will soon begin the construction of its road from Aberdeen to this city.

Walla Walla, Wash.—The Walla Walla Traction Co. is planning to construct an electric line from Spokane through this city to the Columbia River within the next year.

Tacoma, Wash.—The Tacoma Railway & Power Co. is completing the double tracking of the line to South Tacoma. Work has been resumed on South Fifty-sixth Street near Alaska.

Washington Water Power Company.—D. L. Huntington, general manager, has placed an order for 400,000 feet of underground ducts for its light and power wires, on which work will begin in May. The ducts are to be laid within the fire district, and the work contemplated will complete the underground system which was started.

Spokane & Inland Empire Electric Railway.—Jay P. Graves, president, announces that the company's engineers will make a preliminary survey of the branch proposed by citizens of Rockford, to run through that town and through the Rock Creek Valley into the Coeur d'Alene Reservation in Northern Idaho, and if they reported a good grade he will go over the route with outher officers of the company with a view to building the line

Columbia & Walla Walla Valley Traction Company.—Plans are being worked out to give the company a line from Spokane to the Columbia River by way of Walla Walla, Wash. J. H. Morrow, manager of the company, is in Spokane to enter negotiations with the Spokane & Inland Empire people for connections. Work on the Columbia & Walla Walla line will start in the near future, and the system will be rushed to completion as rapidly as possible.

Inland Power Company.—G. Scott Anderson, of Wallace, Idaho, part owner of the Big Creek water, right, upon which he and his associates have expended $20,000 to keep the proposition in life, has organized a company to be known as the Inland Power Company. The incorporators are: Stephen P. Wright, Butte, Mont.; G. Scott Anderson, Wallace; Maurice W. Bacon and William H. Hall, Butte, Mont.; and James J. Maloney, of Chicago. The stock is fully subscribed. Work will begin in May.

Inter-Valley Traction.—Two hundred and fifty miles of electric motor roads will be constructed in Central Washington by The Inter-Valley Traction Company, which has just received a franchise to use the Yakima County highways, west of Spokane, for fifty years. It is estimated by H. B. Scudder, president of the company, that the line can be built and equipped for $10,000 a mile. E. M. Kenly, chief engineer, announces that the first line to be built this year will be to Zillah, twenty-five miles southeast of North Yakima, to Moxer Valley and Parker; the second will run west to Wide Hollow with a loop through Fruitvale; the third to Ahtanum Academy, and the fourth to Cowiche Valley, in all, sixty miles.

Gasoline electric motor cars will be used on the line, each engine having sufficient power to haul several passenger coaches with seating capacity for forty persons, and freight cars of sixteen tons capacity will also be operated. The company expects ultimately to tap the headwaters of the Yakima River, tapping rich farming, timber and mineral districts. Money is being raised by subscription, and it is given out officially that the capital stock of $250,000 has been fully subscribed. The officers of the company are Yakima men, as follows: President, H. B. Scudder; vice-president, W. A. Bell; secretary, M. B. Miles; treasurer, W. L. Steinweg; trustees, A. J. Splawn, Alexander Miller, I. H. Dills, D. E. Lesh and William P. Sawyer.

Northwestern Corporation.—Isaac W. Anderson, of Spokane, president, announces that among the plans for the immediate future of the company, a $5,000,000 concern, recently incorporated, controlling the lighting and power of nearly a score of cities in Washington, Oregon and Idaho, are the construction of a large power plant in Oregon; the building of a great railroad in the Willamette Valley; traction lines in the city of Eugene, Ore.; and interurban lines in that vicinity; and the extension of traction lines in Walla Walla, Washington. The properties consolidated are:

The holdings of the Northwestern Gas and Electric Co., at Walla Walla, consisting of a gas plant; a power plant on Mill Creek; power plant on the Walla Walla River, capable of generating 3,000 horsepower, and supplying power to Walla Walla, Pendleton and Milton; also the city electric system of Walla Walla and the interurban line to Milton, eleven miles distant; the gas plant at Lewiston, Idaho; The Yakima Gas Company; the holdings of the Baker City, Oregon, Light and Power Company; the Willamette Valley Company's gas, electric light and water plants at the cities of Eugene, Albany, Cottage Grove, Corvallis, Independence, Dallas and Seaside, in Oregon; the Boise, Idaho, Traction Company, which operates the street cars at the Idaho capital, as well as furnishes power, and the lighting plant at Athena, Oregon. The directors are: Isaac W. Anderson, Robert E. Allen, R. F. Brackett, Thomas Michelson, A. K. Dice, S. A. Scott, Otto B. Frank, Robert Breese, Nicholas Lawson and Cary M. Rader. The bulk of the stock is owned by Rhodes, Sinkler & Butcher, of Philadelphia.

POWER AND LIGHT.

Albany, Ore.—Walter Mackey proposes to erect a power house here with a capacity of 33,000 horsepower.

Afton, Wyo.—The Afton Electric Light Co. has purchased the local electric light plant from B. E. Blussen.

Indian Head, Sask.—The city is preparing to spend $25,000 on improvements to the electric lighting system. T. E. Donnelly, mayor.

Casper, Wyo.—The Casper Electric Light Co. is contemplat-

ing the erection of a new and larger plant. Nathan C. Johnson, manager.

Prosser, Wash.—The Prosser Falls Land & Power Co. has purchased the property and franchises of the Prosser Electric Co.

Spokane, Wash.—Electric drills are to be installed at once on the property of the Coeur d'Alene Champion Mining Co. J. T. Omo, of this city, is a stockholder.

Kalispell, Mont.—Plans are being prepared by the Flathead Valley Water Power Co. for improvements to the Big Fork Electric Power & Light Co., to cost $50,000.

Dawson, Y. T.—William Ogilvie has organized a company with a capital of $10,000,000, and has purchased three modern dredges for operation on Stewart river.

Basin, Wyo.—The Basin Electric Light & Power Co. is contemplating the installation of additional boiler of 85 horsepower in the near future. F. E. Frisby, manager.

Seattle, Wash.—City Electrician Howard Joslyn is at work on plans for an underground system for the fire alarm wires and the police telephone and telegraph lines.

Hoquiam, Wash.—Work has been commenced clearing the site for the new power plant to be built by the Grays Harbor Railway & Light Co. Estimated cost, $200,000.

Bellingham, Wash.—The Great Excelsior Mining Co. will install a cyanide plant to have a capacity of 100 tons daily at its mine on the Mount Baker district. Estimated cost, $20,000.

West Seattle, Wash.—H. A. Edin has applied for a 25 year franchise for supplying the city with heating and illuminating gas; also for a 25 year franchise for electric light and power.

Spokane, Wash.—The Washington Electric Supply Co., capital $250,000, has been incorporated by Roger C. Kemp of Butte, Mont., Lester M. Simpson and William C. Jones.

Portland, Ore.—The Pacific Light & Power Co., capital $50,000, has been incorporated by C. P. Houston, Junction City; D. A. Houston, Oregon City; and Alexander Sweek, of this city.

Spokane, Wash.—The Mexico Mining & Development Co., capital $2,000,000, has been incorporated by Frank S. Farnest, Benjamin F. Parker, J. L. Reynolds, Joseph H. Horseman and George A. Cegal.

Olympia, Wash.—The Olympia Gas & Power Co., capital $100,000, has been incorporated by A. E. Wright, W. S. Dole and E. M. Kennard, of Portland, and Emil Martensen of this city.

Salem, Ore.—The Idaho-Oregon Light & Power Co., capital $7,000,000, has been incorporated to generate and utilize electricity for light and motive power in eastern Oregon and Idaho.

Lowell, Wash.—P. E. Hall, Jr., has made application to the county commissioners for a franchise to construct and operate a plant for the manufacture of gas for illuminating fuel or power purposes at this place.

Mullan, Idaho—A quantity of machinery, including a compressor plant and electric motors, has been ordered for the National mine, the bonanza silver-lead property on Snowstorm hill, near here. Estimated cost, $10,000.

Astoria, Ore.—The Astoria Electric Co. has awarded contract to W. S. Dole & Co., of Portland, for the construction of its new gas plant here to cost $12,000. C. A. Coolidge, superintendent.

Evanston, Wyo.—The Evanston Electric Light Co. has under consideration the installation of a 50 kilowatt direct current unit, Corliss engine and two 125 volt machines for operating an Edison three-wire system. L. E. Raney, manager.

Hermiston, Ore.—The Western Mutual Electric Co. has been incorporated with a capital of $50,000, by Jas. Lee, E. P. Todd, and others to supply electricity for lighting and power to the territory under the Umatilla government project.

Boise, Ida.—C. J. Franklin, who is in charge of the construction work at the Swan Falls plant reports they are making good progress. Four new water wheels have been set and other machinery is expected soon. There are to be two generators with a capacity of 750 kilowatts each.

Spokane, Wash.—It is reported that the Kendall Mining Co., which owns the Kendall mine in Montana and is controlled by Finch & Campbell, of this city, has purchased Terence McDonnell's water rights. An electric power plant will probably be erected at the Beaver site this summer.

Wallace, Idaho—The Snow Cliff Copper Mining Co., Ltd., capital $1,500,000, has been incorporated by E. A. Piersol, H. C. Small, P. M. Schaeffer, C. A. Burke and J. O. Burns. The Victor Mining & Smelting Co has been incorporated with a capital of $100,000 by Guy G. Bailey, James H. German, A. P. Reinhardt and Katherine A. Marshall.

Everett, Wash.—Eastern capitalists represented by M. Kirkpatrick, will erect a large power plant near Sultan. The dam will be 80 feet thick at the base and 30 feet on top, three separate power houses are to handle the released waters. The company will build a 17-mile railroad to handle its construction material.

INCORPORATIONS.

San Francisco, Cal.—The Fagan Electric Co. has been incorporated with a capital stock of $25,000, shares $10 each.

Eugene, Ore.—The Great Northern Mining Co., capital $100,000, has been incorporated by S. E. Wrightman, H. C. Mahon and George G. Gross.

Butte, Mont.—The Mines Exploration & Development Co., capital $50,000, has been incorporated by J. J. McHatton, J. L. Templeman, E. L. Mayo, W. L. Renick and John N. Kirk.

Hanford, Cal.—The East Cross Creek Ditch and Water Co. has been incorporated here, the directors being Robert Doherty, W. H. Smith, and Thos. McCarthy of Hanford.

San Diego, Cal.—The Distilled Water and Bottling Company has been incorporated with a capital stock of $20,000. The directors are F. W. Bradley, H. S. Richards and others.

Fresno, Cal.—The Coalinga Mohawk Oil Co. has been incorporated here with a capital stock of $500,000. Among those interested are P. S. Turnbull, C. G. and W. D. Wilcox, A. J. and R. W. Graham.

San Luis Obispo, Cal.—The Santa Rosa Oil Co. has been incorporated here with a capital stock of $500,000, shares $1 each. The directors are E. S. Rigdon, E. W. Carson, C. Bianchi and B. Corda.

International, Cal.—A local company has been organized to put in an electric light plant, a waterworks system, and an ice plant, with a capital of $20,000. At present the water is all packed in on burros.

San Luis Obispo, Cal.—The Bickmore Oil Co. has been incorporated here with a capital stock of $500,000. The directors are E. M. Payne, A. E. Campbell, C. P. Kaetzel, J. D. Campbell, and H. M. Payne.

Visalia, Cal.—The Linda Loma Water Co. has been incorporated here with a capital stock of $10,000, the major part of which is already subscribed. The directors are Fred and Daniel Sturm and G. W. Price.

Santa Cruz, Cal.—The Davenport Light and Power Com-

pany has been incorporated with a capital stock of $10,000. Those interested are E. E. Burgess of San Francisco, E. O. Klipphan of Sacramento, and J. S. Thompson of Mill Valley. Valley.

Santa Ana, Cal.—The Newport Bay Oil Company has been incorporated with a capital stock of $2,500,000. The directors of the concern are George Huntington, W. H. Beman, F. C. Fuller, C. F. Love, W. H. Bisbee, S. Cannon and others of Los Angeles.

North Yakima, Wash.—The Summit Copper Mining Co., capital $1,000,000, has been incorporated by Dan Sinclair, P. J. Bawalda, Mart Schichtl, John Nywening and Richard Strobach.

Seattle, Wash.—The Utah Copper Co., capital $600,000, has been incorporated by N. W. Chapman and Alex McCartney.

Berkeley, Cal.—Articles of incorporation have been filed by the Great Western Power Company, with a capital stock of $25,000,000. The corporation is building a large power plant on the west of the Feather River above Oroville, from which is proposed to run power lines into Berkeley, Oakland, and San Francisco. Henry Brown, a representative of the company, is in Berkeley looking over the field preparatory to asking for a franchise to run a pole line through various streets.

OIL.

City of Mexico.—The Mexican Central is installing oil burning engines as fast as they can build the tanks for storage along its line. Oil reservoirs are to be constructed at once between Monterey and Tampico and between Monterey and Torreon.

Crockett, Cal.—Although during the past year much construction work has been done at the refining plant of the Union Oil Company at Oleum, the information is given out that the plant will be increased to twice its present size because of the growth of business.

Bakersfield, Cal.—The Twenty-five Oil Co. has amended its articles of incorporation so that it now has the power to drill for and produce oil on its lands in the Midway field. Heretofore the company has not had this power under the articles of incorporation, but has been restricted to buying, selling, and leasing oil lands.

Portland, Ore.—Lower trans-continental tariffs on petroleum and its products are being published by the traffic departments of the railroads. Present freights of 78½ cents from Chicago and $1.06 from the Coast will be cancelled. Freight on turpentine in tank cars has been advanced from $1.10 to $1.25 per 100 pounds in tank cars from the East to North Coast terminals. A uniform standard of 7.4 pounds to the gallon of crude oil and 6.4 pounds for a gallon of refined oil has been adopted by the railroads.

Watsonville, Cal.—George E. Brookins, representing wealthy Los Angeles people, has completed negotiations for the sub-leasing from the Watsonville Oil Company of 200 acres of the Sargent ranch for oil boring operations. The location secured is considered a good one by oil experts. The Los Angeles company has plenty of money to prospect the ground thoroughly. The Watsonville Oil Company expects to increase its daily output considerably in a short time, when the casing of the deep well is perfected.

Bakersfield, Cal.—The arrival of the Standard pipe and the start of the work on the new pipe line has turned all eyes to the Midway and Sunset oil fields. Work on the new refineries, both on the Spreckels property and that of the Sunset Refining Company is being rushed as fast as possible. New development has been started on many of the leases. Among those who will put down new wells in the near future are the Krausbergers, the Bull's Head Oil Company, and the Birch Oil Company. Several new rigs are at work on the Monarch and Mascot properties.

Vallejo, Cal.—Fuel oil for the use of Vallejo and Napa consumers will be landed at Glen Cove, between this city and Benicia, and a pipe line is to be run from the bay inlet to these two cities. The oil will be piped across the country and sold at prices considerably below those now charged. George Ryerson is grading a ten-acre tract, which will be covered with oil tanks and other buildings necessary for the new enterprise. It is believed that the promoters of the new plan are also after the business of supplying the Government for the Mare Island Navy Yard, which uses vast quantities of fuel oil annually.

San Francisco, Cal.—Three of the largest petroleum companies of the Santa Maria Oil field and the Standard Oil Co. have consummated a deal that is without a parallel in the State. The contract, which represents $3,000,000, means an output of 145,000 barrels a month, a great stimulus to the industry. The Pinal, Brookshire, and New Pennsylvania are the independent companies, and the high price of 50 cents a barrel is quoted. All these independent companies adjoin one another in the Santa Maria field. Recently they and the Standard clashed over the price, which was quoted at 29 cents. They had offered to place the oil on the market and fight the Standard when the deal was made.

TELEPHONES AND TELEGRAPHS.

Coeur d'Alene, Idaho—The Interstate Telephone Company will expend $30,000 in improving its system in this city.

Boise, Idaho—The Independent Telephone Company is extending its lines to Nampa, Caldwell, Payette, Weiser and Emmett.

Fernie, B. C.—The Revelstoke Trail & Front Lake Telephone Co. will build a long distance line to Elkmouth and Hosmer.

Dexter, Ore.—The Dexter Telephone Company has applied for a franchise to extend its lines from Dexter to Springfield.

Spokane, Wash.—Contract has been awarded to Fife & Connor for $20,000 for blasting and stone work for ditches for the Home Tel. Co.

Tacoma, Wash.—The Home Tel. Co. will erect a one-story brick sub-station at once, to cost $15,000 at South Forty-fifth and L Streets. Plans by Russell & Babcock.

Wallace, Idaho.—Work has been commenced on the new building to be erected by the Rocky Mountain Bell Telephone Co. on Sixth Street, to cost $30,000.

Anaconda, Mont.—Work has been commenced remodeling the building formerly occupied by the Electric Light & Power Co., for the use of the Montana Independent Tel. Co.

Missoula, Mont.—The Peoples' Telephone Company has been incorporated with a capital of $10,000, by F. M. Taylor, K. D. Prescott, J. A. Moss and W. R. Hamilton.

Missoula, Mont.—The people of Orchard Homes and Cold Springs district are planning the construction of a telephone line. Messrs. Finkelnberg and Irving are interested.

Gig Harbor, Wash.—The Bay-Island Telephone Company has been organized by M. Magnuson, J. G. Schindler, H. Knapp, W. E. White, Wm. Schlaub, C. D. Fuller and R. Elmdorf.

Chehalis, Wash.—The Northwestern Long Distance Telephone Co., which purposes to connect Portland with Tacoma and

Seattle, has been granted a 50-year franchise by the Lewis County Commissioners.

Spokane, Wash.—F. C. MacGougan, manager of the Pacific Telephone and Telegraph Company, announces that from $500,000 to $750,000 will be expended in the betterment of the service here.

Wenatchee, Wash.—The Pacific States Telephone Co. has merged with the Farmers' Co., which will also handle long distance business. The Pacific States Co. will remain out of the field for ten years.

Dell, Mont.—Bids will be received by Walter J. Crowell, secretary of the Dell Tel. Co., until April 15, for the construction of 60 miles of telephone lines connecting Dell with Lima, Crabtree and Sheep Creek basin.

Gifford, Idaho.—A number of farmers' telephone lines, including the Riggers-Jacks line from Riggers' mill, the Hamberly-Slocum line from Hamberly ranch, and the Boyer-Bluett lines, are building into this place.

Eureka, Cal.—L. F. Puter, an attorney of this city, has been retained by the agent for a syndicate of Los Angeles capitalists to appear before the City Council to ask that a telephone franchise be offered for sale by the city.

San Jose, Cal.—There are persistent rumors here that a home telephone company is being formed and will ask for a franchise from the city at an early date. It is stated that petitions for franchises are even now being prepared.

Buffalo, Wyo.—The Klondike Telephone Co., capital $1,000, has been incorporated by J. Elmer Brock, R. Q. Watkins and G. E. A. Moeller. The company will construct, maintain and operate telephone lines in Johnson county.

Harington, Wash.—The P. S. Telephone Co. is building a line to Bluestem and thence to Davenport.

Umatilla, Ore.—The Farmers' Co-operative Telephone Co., capital $5,000, has been incorporated by Omer O. Stephens, De Witt C. Brownell and John W. Duncan.

Oakland, Cal.—At a meeting of the City Council last week a resolution of the Board of Public Works recommending that the telephone franchise awarded to W. A. Beasley on November 17, 1902, be declared forfeited as the grantee had failed to fulfill the terms of the franchise was referred to the ordinance and judiciary committee. William Thomas, president of the Home Telephone Co., filed with the City Council an affidavit that the company, in accord with the terms of its franchise, had already spent $250,000 in the installation of its system in Oakland.

San Jose, Cal.—It is probable that an ordinance will be adopted by the City Council within a week requiring that all wires, telegraph, telephone, and power, be placed underground. A committee from the Board of Fire and Police Commissioners has been investigating the matter and has formulated a report which is very sweeping in its recommendations.

Whitmore, Cal.—The farmers of this section have organized a telephone company for building a line to Redding, a distance of twenty-eight miles. The officers of the company, which is named the People's Telephone Co., are Jos. Covey, president, and Geo. R. Milford, secretary.

Oakland, Cal.—The Pacific Telephone and Telegraph Co. has started work on a new office at the corner of Forty-fifth Street and Piedmont Avenue. It will be a class A building, two stories in height. It is to cost $50,000 and be finished in October. There will be sixty operators in the new office.

Springfield, Ore.—The McKenzie Telephone Company has applied for a franchise to construct a line from this place to Leaburg. S. J. Godard and W. B. Wheeler were granted permission to build a telephone line from here to Wheeler's store, a distance of nine miles.

Waitsburg, Wash.—Stockholders of the Waitsburg Rural Telephone Company have granted a ten-year lease of the system to the Pacific States Telephone Company. The system comprises twenty-one lines and two hundred instruments.

San Francisco, Cal.—Emile J. Zimmer of the Pacific States Telephone Company was seriously but not fatally injured in a collision between a hack and a street car last week. Mrs. Wellington Gregg, wife of the cashier of the Crocker National Bank, who was in the hack with Zimmer, was unconscious for some time after the accident, and sustained severe injuries.

WATER WORKS.

Hemet, Cal.—Superintendent Salmon has begun work on the reservoir on Park Hill to contain 700,000 gallons of water. The reservoir will be formed by building a dam across a ravine near the top. Later a pumping plant will be installed.

San Francisco, Cal.—Bids have been advertised for by the Depot Quartermaster of the U. S. Army for the construction, plumbing, electric wiring, etc., of a pumping station and for the construction of a 300,000 gallon reservoir at a new military post, Kahauiki, Honolulu, H. T. Plans and specifications can be obtained at the office in San Francisco.

Rhyolite, Nev.—Dr. W. S. Phillips of Chicago, and Beatty and Malcolm McDonald, the Nevada mining operators, are at the head of a movement to build a great reservoir at Beatty to supply the contemplated mills of the Bullfrog district and to furnish water to the towns of Lee, Nev., and Lee, Cal., as well as to the mines of the Funeral Range. The new company will probably be incorporated with a capital stock of $1,000,000.

Goldfield, Nev.—The Colorado Nevada Mining and Prospecting Company of Denver has two claims in the northeastern portion of Death Valley. It is the intention of the company to install a graduated pipe from a spring two miles away to the mine and build a 20-stamp mill on the ground. A screen will be placed around each stamp, thus saving every particle of ore during the jamming process. W. J. Lee is superintendent of the company.

Madera, Cal.—The Madera Water Company reports that improvement of its water system will be made at once. A fire and a commercial pump are now being built at San Francisco for the plant. The capacity will be 60,000 gallons per hour under pressure of 100 pounds per square inch, which will be sufficient to furnish four fire nozzles with water. These will be built so they can be driven by either steam or electricity and can be changed from one to the other at short notice.

Oakland, Cal.—Members of the City Council made an examination of the People's Water Company's plant a week ago, in so far as the Alvarado pumping station and Lake Chabot dam and water shed were concerned. City Engineer Fred C. Turner accompanied the party. Automobiles were taken from Oakland to Alvarado, thence back to Lake Chabot. Louis Titus, the general manager of the company, acted as guide of the party. At an early date the Council will take up the subject of water rates for the coming fiscal year. Data and statistics as a basis of work on a rate-fixing ordinance are being compiled by J. H. Dockweiler, an expert engineer.

San Francisco, Cal.—Representatives of every commercial district improvement club and central labor organiza-

tion were present at a meeting held last week at the California Promotion Committee's rooms, at which they provided for the organization on May 25 of a central body to begin an active campaign to secure a water supply which shall be adequate to meet the needs of the city. A definite and decisive arrangement with the Spring Valley Co. will be one of the first efforts of the proposed organization. This arrangement, which may be made through the Board of Supervisors, is not to be so much an aid to the Spring Valley Co. as a relief to tide the corporation over and put it in such a shape that it may realize on its bonds and improve its service at least temporarily.

Oakland, Cal.—The People's Water Co. made public recently some of its plans relative to the development of its enormous holdings on the watershed of San Pablo Creek, the battle over which led in large measure to the sale of the old Contra Costa Water Co. to the Syndicate interests. The company has its plans prepared to construct a dam at the Clancy ranch on San Pablo Creek, which will form a reservoir 160 feet deep with an area along the creek five miles long to be flooded. This will provide a supply of 8,000,000,000 gallons of water, with a daily delivery capacity of 8,000,000 gallons. The Oakland Council was informed that the construction work would be completed in two years. The dam will consist of a heavy concrete core, earth faced. Tunnels are being bored on each side of the point selected in which to build the anchorage of the dam. A delivery tunnel, 7½ feet in diameter, will be constructed under Wildcat Creek to carry the water into Berkeley and thence to Oakland. The proposed works will more than double the existing supply. The Council will consider the new project in connection with the fixing of the water rates for the coming fiscal year.

TRANSPORTATION.

San Diego, Cal.—The Point Loma Electric Railway has applied for a franchise to construct a line from Winder and India Streets to Ocean Beach and has had the route fully surveyed.

Santa Ana, Cal.—The Santa Fe is preparing to make a fight for a franchise to run cars on East Second Street. People say that the company is getting ready to run an electric line from Huntington Beach to Santa Ana as a feeder for its traffic.

Chivatera, Mex.—Workmen are busy grading and laying track for the new motor line being built from the Capote framing shed to the Oversight mine. The equipment for the new road will consist of a motor and ten flat cars. The track will be eighteen inches wide.

Stockton, Cal.—An application has been made by the Central California Traction Company for a franchise for a term of forty years to operate cars for the transportation of passengers and freight on certain streets of this city. The cars will be operated by electricity.

Stockton, Cal.—The work of constructing the Central California Traction Co.'s line from Stockton to Lodi was commenced last week. The contractor will put 100 teams at work and expects to have the road in operation within six weeks. The line is already constructed from Stockton to the Calaveras River.

San Diego, Cal.—Within a week the work of double tracking the Third Street line will be under way. Material for this is being distributed along the line. Arrangements have been made for the construction of a bridge across the canyon running from Brooks to Pennsylvania Avenues. The work will cost thousands of dollars.

Vallejo, Cal.—Col. Fred Stock of San Francisco, who has been endeavoring to finance the San Francisco, Vallejo and Vaca Valley Railway and Steamship Co. and the Marysville and Downieville Railroad Co., is now in Paris and prospects are said to be good for a commencement of operations on both prospects late this summer.

Los Angeles, Cal.—Manager T. R. Gabel of the Los Angeles Pacific Railroad has notified the Board of Public Works that he will tear up South Hill Street from Second to Sixteenth to put in third rails. The object is to make the line broad gauge. Orders that no streets be torn up until after the fiesta period have been issued by the Board.

San Diego, Cal.—At a meeting of the Board of Supervisors last week bids were opened for the street railway franchise on El Cajon Avenue to La Mesa Springs. The application for the permission was made by E. Bartlett Webster and his bid was $100. The provisions of the grant are that work shall be begun within four months and completed within nine months.

Lincoln, Cal.—The Southern Pacific Co. is arranging for the immediate construction of an electric branch railroad from here to the Dairy Farm copper mine, which is nine miles from here. The Guggenheims, who own the mine, represent to the railroad that they will ship 1,000 tons of ore per day from the mine to the smelter which they are constructing at Baden on San Francisco Bay.

Fresno, Cal.—At the last session of the Board of Trustees a franchise was granted to the Monterey, Fresno, and Eastern road to pass through the city on F Street. Attorney Short, speaking for the traction company, said that his company would retire in favor of the railroad. The franchise was granted with the understanding that the railroad make satisfactory arrangements with the property owners along the line.

Lakeport, Cal.—Articles of incorporation have been filed by the Sonoma and Lake County Railway Co., which intends to construct an electric railway from Cloverdale to Lakeport with a branch to Kelseyville. The survey has been made from Cloverdale to Lakeport with a maximum grade of 3 per cent with one tunnel, the distance being 27 miles. The profiles and maps are being made out and as soon as weather permits work of construction will be begun.

Martinez, Cal.—W. S. Rheems has ordered from the General Electric Company a large quantity of material for the Martinez and Contra Costa electric line, and the General Electric Company has telegraphed the order East.

Los Angeles, Cal.—Bids will be received by the city until May 13 for a franchise for an electric railroad upon certain streets of the city. The proposed road is to run from Bimini Avenue along Third Street to Vermont Avenue and thence to Fourth Street. Certified checks must accompany all bids.

Sacramento, Cal.—Three hundred acres of land were purchased in Sacramento last week by F. J. Woodward and Chas. Butters, of Oakland, for $300,000. Butters holds large interests in the Key Route Co. and the Northern Electric Co. This land, it is said, will be used as the central point of operation for the extension of the Key Route company's lines to the North and South. According to rumors now prevalent here, plans are being laid by the Key Route to network the Sacramento and San Joaquin Valleys with electric railroads.

San Francisco, Cal.—The United Railroads has been directed by the Board of Supervisors to file a statement of its gross receipts for the years 1905 and 1906, which it has withheld from the city. E. P. E. Troy said that the company had furnished the financial papers with a statement that its receipts for 1905 were $7,066,000 and that testimony as to the receipts for 1906 was adduced from the arbitration

proceedings. The company offered to pay the sum of $25,-114.81 as percentages on its gross receips for the year ending December 31, 1905. It claims that its records for 1905 were destroyed in the fire and it offered to settle its obligations with the city on the same basis as for the year 1904. The California Street Railway was directed to pay into the treasury $3,457.40 as percentage on its receipts for the year ending June 30, 1906.

Reno, Nev.—W. J. Harris, a director of the Farmers' and Merchants' Bank of this city, and J. E. Giroux, a prominent real estate man, have applied to the City Council for a franchise for an electric railroad in the northwestern portion of town. They intend to build a network of electric lines through the most important streets and connect that district with the University of Nevada and the business portion of the city. They promise to begin actual construction within thirty days after the granting of the franchise and that they will complete the work within a year. The Fleishakers of San Francisco, who own the Reno Traction Co.'s franchises over the streets in which Messrs. Harris and Giroux wish to extend their lines, are fighting the granting of the new franchises. The Fleishakers have not an exclusive franchise and as the people have become tired of waiting for the Fleishakers to extend their lines, they may call upon the Council to grant the new franchise.

FINANCIAL.

San Francisco, Cal.—The sale day of delinquent assessments levied payable on February 14 by the Rio Bravo Oil Company has been set on April 20.

San Francisco, Cal.—The annual meeting of the stockholders of the American River Electric Company has been called for April 17, 2 o'clock p. m. It will take place in this city at the corner of Grant Avenue and Bush Street.

Los Angeles, Cal.—May 15 will probably be settled as the day for holding the Owens River special bond election. The mayor will issue a proclamation declaring a holiday on that occasion and asking for a general celebration of the day, besides asking every one to vote for the $23,000,000 bond issue for the aqueduct project.

Santa Clara, Cal.—Santa Clara carried all but the bond proposition of $20,000 for the erection of a new city hall at the bond election recently. Among the items carried through were $21,000 for repairs to the municipal water and light plant, $9,000 for repairs to the school buildings and $30,000 for repairs for the sewers.

San Francisco, Cal.—Telegraphic advices sent to New York state that the United Railroads of this city have had to face an expenditure of $4,294,271 between March 1, 1906, and March 1, 1907, due to the earthquake and strike and betterments and improvements. This had all been provided for so that the company on March 1, 1906, had current liabilities amounting to $2,310,209, against which it had current assets of $2,177,410. In addition to this it had sold securities which were delivered in March that netted it an amount in excess of $900,000, and still left in the treasury over $2,500,000 of its 4 per cent consolidated bonds. It is claimed that by the sale of securities the $4,294,271 above mentioned has been provided at a cost not exceeding 5 per cent interest.

Los Angeles, Cal.—The right of any or every municipality in the United States, and more especially in California, to own public utilities is the important point at issue in a case brought before Judge Olin Wellborne of the Federal District Court last week. The suit is instituted as a test by the Edison Electric Company against the city of Pasadena to determine the right of the latter to buy the plant of the former. The electric corporation raises the contention that it is unconstitutional, under the Fourteenth amendment of the United States Constitution, for a city to obtain such ownership. The claim is made that no municipality in this State may engage in competition with private citizens, because the California law provides immunity from taxation to cities, thus affording them an unfair advantage, in violation of the constitutional amendment referred to. On account of the vital questions involved attorneys are watching every phase of the case. Able counsel represent both sides.

San Jose, Cal.—The answer of the Spring Valley Water Co. in the condemnation suit brought against it by the Bay Cities Water Co. has been filed last week. In the document the Spring Valley company fixes the value of the small strip of land which is in controversy at $1,000,000. The suit was brought by the Bay Cities company some time ago to condemn the land, which lies directly across the proposed reservoir site of the Bay Cities company at Coyote, where the company has erected extensive works for the diversion of the waters of the Coyote River. The plaintiff contended that the land had been purchased by the Spring Valley company, the Suburban Co., and the San Jose Water Co. for the purpose of hindering the construction of the reservoir. In answering the Spring Valley accuses the Bay Cities company of securing the water rights for speculative purposes only. It avers that the land in question is essention to its own business and that it is worth $1,000,000. The indications are that there will be a bitter legal controversy over a spot of land that is intrinsically almost valueless.

Los Angeles, Cal.—Local capitalists interested in the Home Telephone Company have given out the following statement: "Statement concerning the Home Telephone franchise to the city of San Francisco: Cash paid for franchise to the city of San Francisco, $100,000. The requirement was that the price be in gold, and this being impossible right after the fire, $25,000 was paid to the city and $75,000 was given by certified check to the relief fund. Under the provision of the franchise the city acquires the use, free of charge, of 600 telephones, the estimated to the city being $8 per month each, or $57,600 per year, being five per cent. interest on nearly $2,500,000. The telephone company under the Broughton Act, is required to pay two per cent. of the gross receipts after five years to the city granting the franchise. The gross receipts after five years are estimated to be the proceeds of 50,000 telephones paying an average of $6 per telephone per month. This would amount to $300,000 per month, two per cent of which would total not less than $72,000 per year. It has been stated by one familiar with franchises granted by municipalities that the actual consideration paid for the telephone franchise in San Francisco was the highest ever paid by any corporation for any purpose in any city in the world."

TRANSMISSION.

Petaluma, Cal.—It has been decided that the Petaluma Gas and Electric Co. will build a steam power plant here of capacity 2,000 horsepower for the generation of electricity.

Mexico City, Mex.—The council of administration of the Electric Power Transmission Co. of the State of Hidalgo announces that at the general meeting of the shareholders recently held it was decided to acquire two more waterfalls, erect more electric generating plants, and issue more stock.

San Francisco, Cal.—Reviewing the electrical workers' strike situation, Secretary George E. Russell said last week

"Work has come to a standstill on twenty-five large concrete buildings in course of construction and on countless smaller structures. The George Wellington Company has been obliged to cease operations on ten structures, and the Frank Gilbreth Company on at least an equal number."

Red Bluff, Cal.—A great many water claims have recently been filed here and the water in all the main streams has been appropriated. Recently two claims were filed for water from the Antelope Creek, each for 15,000 inches of water. The appropriators are C. A. Buress, L. J. Joiner, and E. Finley. The water is to be used for power purposes.

Stockton, Cal.—Ground has been broken by the American River Electric Power Co. for the erection of its immense new power house on Banner Island. Nearly all the machinery for the equipment of the plant is on the ground, and the remainder is on cars on the way from the East. The work of putting in the concrete foundations will be hurried to completion and the machinery will be installed soon after. This plant will be to supply local customers, notably the traction company.

Bishop, Cal.—The application of the Mono Power Company for a river water right has been approved by the Secretary of the Interior. The company has had a long fight against the opposition of Los Angeles. The report, which was approved by the President, sustained all the contentions made by the Mono Power Company and against the city of Los Angeles. The grant is for the company's full claim, except in the case of construction of the Long Valley reservoir; should that be built the company will be restricted to 160 second feet, or 8,000 inches.

Stockton, Cal.—Millions of dollars are being expended in the development of the Stanislaus Electric Company's properties in Tuolumne and Calaveras Counties. One of the greatest electrical enterprises in the West is being developed in the watershed of the Stanislaus River with a generating plant to be located on the river a few miles above the Melones mine. Thence power lines will be run to Stockton and thence to San Francisco. The general distributing point for the company's operations is at Middle Camp in Tuolumne County, to which point a narrow railroad has been built from a connecting station on the Sierra Railway. The work has progressed far enough to warrant the location of the pole line which is to be built to Stockton.

Watsonville, Cal.—The visit of General Manager Stirling and Secretary Fitzpatrick of the Coast Counties Light and Power Co. to this place last week, while virtually a visit of inspection, also portends a number of changes in the operation of the plants supplying Santa Cruz and Watsonville with light and power. It will be fully a year before the changes are completed, and almost the last move to be made is the one bearing on a reduction of the size of the auxiliary plant now in operation at Watsonville. The company's plan, as briefly outlined, is to establish a large central plant at Big Creek at which the electricity is to be generated, and a large substation or distributing plant at Santa Cruz, with a smaller auxiliary plant at Watsonville to be used in emergency. The generating plant at Big

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California Electrical Works
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Tel. and Elec. Equipment Co.

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Century-Klein Electric Co.
California Electrical Works
Northern Electrical Mfg. Co.

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Allis-Chalmers Co.
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STATION RECORDS

BY J. D. ROSS*

Although the system of records of a lighting and power concern must necessarily differ with varying conditions, there is much in common with all plants, and the student just entering the field may profit much from the experience of those who have been connected with a plant during its installation and as it has grown, have tried to give it a proper system of records.

THE CITY OF SEATTLE

DEPARTMENT OF LIGHTING AND WATER WORKS

INSTALLATION WORK CARD

ORDER NO. ___________
STREET LIGHTING

Date ___________________

Install at ____

AN INCANDESCENT STREET LAMP

Return this Card with record of material used as indicated on reverse side. Also time record.

REMARKS

____

____

____

CARD 1 OBVERSE

In arranging such a system for the Seattle municipal plant, we have tried to search out the best ideas from other concerns and modify them and make additions to suit conditions.

Beginning with our hydraulic plant situated in the Cascade Range, forty miles from Seattle, our first record is that of the water level where it leaves Cedar Lake, the impounding reservoir of the plant. This level is taken once a day in order that the amount of water for any future development may be computed from the records of several years.

In a generating station it is usually customary to have but one printed blank ruled in columns with headings for K. W., amperes, volts, power factor, etc., for each generator according to the instruments supplied on the board. In addition to this, a system of automatic records using recording instruments will well repay the cost. These may be made by Bristol meters or by curve tracing meters as in the case of load and power factor. A careful examination of these leads to a better understanding of the problems of transmission and regulation. If automatic records are not used the back of the daily record blank may be ruled in cross section and the load curve filled in each day. The exact records required in a station and also the engineering records of the substation will depend largely on the nature of the service and the switchboard design and of course will differ considerably if steam is used.

A somewhat similar system will be used by the substation operators, but we now have receiving transformers instead of generators and we will have in addition a number of distributing circuits, some of which may be direct current, requiring rotaries or motor generators. The record will have to be arranged to suit these conditions. It should, however, duplicate that at the station as far as possible, in order that a comparison of the two records will show the transmission losses and regulation. Besides the operator's station blanks, there are several needed in the general operating of the plant, and these will be considered together with those used for installation work. In the construction and operation of pole lines and wire lines, several maps are required. The map for recording pole locations may conveniently be drawn to a scale of 100′ equals 1″. This map shows the location and length of pole, and the scale is large enough to show which side of the street or alley is used. In a fast growing city like Seattle, it is economical to have these records in the hands of one who keeps in touch with the City Engineer's office, so that all poles may be placed in the parking strips or at the edge of sidewalks. On ungraded streets, if grading plans are finished, it is possible to locate poles accurately and save time and money that would be spent in moving them. A map of the above scale may be conveniently made in sections 36 in. x 24 in., and put

*Lecture Delivered to Class in Electrical Engineering at the University of Washington, Seattle, Wash.

ELECTRIC SERVICE CARD

THE CITY OF SEATTLE—LIGHTING DEPARTMENT

Appl. No.................... Date of Order ....

Cut in Service for Residence / Business Lighting

At...

Owner's Name ....

Tenant's Name ....

CITY / CUSTOMER } to furnish the following lamps for which current is required:

INCANDESCENT				ARCS			NERNSTS	
4 C. P.	8 C. P.	16 C. P.	32 C. P.	4 A	6 A	7½ A	..............Glo	..............Glo

Service Crew Foreman Fill Out All Blanks

Date of Cut-in .... 190...

..........................Wire System ....Side
2 or 3 N. E. or S. W.

No. of nearest Transformer on bus..............................

Service Pole .... No.............
Owner's Name

Service Pole Location..

....

Signature...

V. B. 448-12-27-06-4M Over

CARD 5 OBVERSE

MATERIAL USED

....x....Bolts	.... L. Brackets
....x....Bolts	.... Corner Brackets
.... ft. No....W. P. Wire	.... Double Loop Brackets
.... ft. No....W. P. Wire	.... Single Loop Brackets
.... 2-pin Cross Arms	.... Right or Left Brackets
.... 4-pin Cross Arms	.... Roof Brackets
.... 8-pin Cross Arms	.... Eye Bolts
.... Wood Pins	....in. No.....Screws
.... Iron Pins	....x....Lags
.... Circuit Br.	....x....Lags
.... Porc. Insul.	....in. Conduit
.... Glass Insul.	....in. Loom
.... Cast Washers	.... Solder
.... Cut Washers	.... Flux
.... Cross Arm Braces	.... Screws
.... Tape	.... lbs. Nails
.... Screw Hooks	....

TIME

......Hrs. Foreman

......Hrs. Lineman

......Hrs. Helper..

......Hrs. Team....

CARD 5 REVERSE

ELECTRIC SERVICE CARD.

CITY OF SEATTLE—LIGHTING DEPARTMENT

Appl. No............................ Date of Order..........................

CUT IN MOTOR SERVICE

At...

For..

Current is required for the following Motors:

No.	Size in H. P.	D. C. Voltage	A. C. Volt	A. C. Ph.	Customer will
....	....	....	....	....	....
....	....	....	....	....	....

Blanks Below and on Back of Card to be Filled Out by Service Crew Foreman. MUST BE COMPLETE.

Date of Cut In..190.....

..........................Wire System ....Side.
2, 3 or 4 Street or Walk

Connected to Transformer (or bank) No............................

Located at...

....

And to transformer (or bank) No...................................

Located at...

....

Signature..

CARD 6 OBVERSE

MATERIAL USED

....x.........Bolts	.... L. Brackets
....x.........Bolts	.... Corner Brackets
.... ft. No.......W. P. Wire	.... Double Loop Brackets
.... ft. No. .....W. P. Wire	.... Single Loop Brackets
.... 2-pin Cross Arms	.... Right or Left Brackets
.... 4-pin Cross Arms	.... Roof Brackets
.... 8-pin Cross Arms	.... Eye Bolts
.... Wood Pins	....in. No....Screws
.... Iron Pins	....x.........Lags
.... Circuit Br.	....x.........Lags
.... Porc. Insul.	....in. Conduit
.... Glass Insul.	....in. Loom.
.... Cast Washers	.... Solder
.... Cut Washers	.... Flux
.... Cross Arm Braces	.... Screws
.... Tape	.... lbs. Nails

TIME

.........Hrs. Foreman

.........Hrs. Lineman

.......Hrs. Helper......

.........Hrs. Team.....

CARD 6 REVERSE

up in book form with heavy covers. Each section has its page number corresponding to the same number on an index map drawn to a scale of 800′ equals 1″. For wiring maps the same scales are convenient, and if the prints are positive the different phases and voltages may be kept distinct by using different colored inks. Cut-ins are best recorded in pencil, as they are subject to change.

In installation work on street arc and street incandescent lamps, we issue a work card containing order number, date, and location, and on the back of the card is a list of material used in this work, with space opposite to insert the amount used by the crew on that work order.

For cut-ins for light and for power the same system may be carried out, but in addition the card will contain the customer's name and house number and application number, as well as information filled in by the inspector as to

ELECTRIC METER CARD

THE CITY OF SEATTLE—LIGHTING DEPARTMENT

Appl. No............... Date of Order...................

Install Meter for Residence / Business Lighting

At ....

Owner's Name........ ....

Tenant's Name...

CITY / CUSTOMER to furnish the following lamps for which a meter is required:

INCANDESCENT				ARCS			NERNSTS	
4 C. P.	8 C. P.	16 C. P.	32 C. P.	4 A	6 A	7½ A	.... Glo	.... Glo

Meterman Fill Out Blanks Below

Date Installed...

Meter No.................... Factory No...........

Make................................Type.........................

Form ....Class...........................

Cap'y............Amp......Volt...........Multiplier.........

Location......... ....

REMARKS

....

....

....

....

....

V. B. 381 9-20-3M **OVER**

CARD 7 OBVERSE

INCANDESCENT LAMPS

Candle Power	4	8	16	32	Candle Power	4	8	16	32
Porches					Pantry				
Halls					Chambers				
Parlor					Basement				
Sitting Room					Attic				
Dining Room					Shed				
Library					Barn				
Kitchen					Shop				
Bath Room					Store				
......									
......									
......									

ARC AND NERNST LAMPS

....

....

....

....

....

....

....

MATERIAL USED

....

....

....Hrs. Meterman

....Hrs. Helper....

Signature..

CARD 7 REVERSE

Quantity of	Material Used	Dollars	Cts.
	Feet No............ Wire		
	Feet No............ Wire		
	Feet Twin Cable		
	Wood Pins		
	Iron Pins		
	Wood Steps		
	Iron Steps		
	Glass Insulators		
	Porcelain Insulators		
	..........Circuit Breakers		
	..........Circuit Breakers		
	Brady Cutouts		
	Iron.......... Brackets		
	Eye Bolts		
	......" x ......" Bolts		
	......" x ......" Bolts		
	......" x ......" Lag Screws		
	Feet Rope		
	Rope Cleats		
	....pin Cross Arms		
	....pin Cross Arms		
	Cut Washers		
	Cast Washers		
	Cross Arm Braces		
	Junction Switches		
	Fuse Blocks		
	Angle Arm Braces		
	Crosby Clips		
	TIME		
	Hours Foreman		
	Hours Lineman		
	Hours Repair Men		
	Hours Ground Men		
	Hours Team		

CARD 2 REVERSE OF CARD 1

CUT OUT CARD.

THE CITY OF SEATTLE—LIGHTING DEPARTMENT

Appl. No................ Date of Order..................

CUT OUT SERVICE

At...

For...

....

Date Cut Out...... ....190..

....

	TIME
....	......Hrs. Foreman
....	......Hrs. Lineman
....	......Hrs. Helper...
....	......Hrs. Team....

....

Signature.................................... .....

\ B. 384 2-10-06-1M **Over**

CARD 10 OBVERSE

MATERIAL RETURNED TO STOCK

......	....x....Bolts	......	L. Brackets
......	....x....Bolts	......	Corner Brackets
.....	ft. No....W. P. Wire	......	Double Loop Brackets
.....	ft No....W. P. Wire	......	Single Loop Brackets
.....	2-pin Cross Arms	......	Right or Left Brackets
.....	4-pin Cross Arms	......	Roof Brackets
.....	8-pin Cross Arms	......	Eye Bolts
.....	Wood Pins	......	....in. No.....Screws
.....	Iron Pins	......	....x....Lags
.....	Circuit Br.	......	....x....Lags
.....	Porc. Insul.	......	. . in. Conduit
.....	Glass Insul.	......	....in. Loom.
.....	Cast Washers	......	Solder
.....	Cut Washers	.....	Flux
.....	Cross Arm Braces	......	Screws
.....	Tape	......	lbs. Nails
.....	....		
.....	....		
.....	....		
.....	....		
.....	....		
.....	....		
.....	....		
.....	....		
.....	....		
.....	....		

CARD 10 REVERSE

MATERIAL REPORT

Power Circuits Const.	
Power Circuits Operat.	
Commercial Lighting Const.	
Commercial Lighting Operat.	
Street Lighting Const.	
Street Lighting Operat.	

LOCATION________________________________

DATE________________________190__

________________________ FOREMAN

BOLTS					WIRE COPPER		WIRE IRON		MISCELLANEOUS					
Inches	3/8	4/8	5/8	6/8	Size	Lbs.	Size	Feet	Glass, Large		Arc Lamps			
2½					8		12		Glass, small		Duplex Wire, ft.			
3					6		6		Brackets, wood		Brady Cutouts			
4					4		5/16		Brackets, iron		Rope Cleats			
4½					2		7/16		Brackets, special		Rope, feet			
12					1		CROSS ARMS		Pole Steps, wood		Cutters, pole pulleys			
14					1-0		No. of Pins	No.	Pole Steps, iron		Cutters, lamp pulleys			
16					2-0		2		Circuit Breakers, oak 15 in.		Cutters, cross arms			
18					3-0		4		Circuit Breakers, oak 30 in.		Cutters, mast arms			
20					4-0		6		Circuit Breakers, porcelain		Goose Necks			
22							8		Circuit Breakers, wood break		Junction Switches			
24									Circuit Breakers, West. Elec		Fuse Blocks			
Cast Washers					Wood Pins				Solder, lbs.		Iron Break Arms			
Cut Washers					Iron Pins				Tape, lbs.		Angle Iron Braces			
Cross Arm Braces					Screws				Wrapping Wire, lbs.		Eye Bolts			
Heel Bolts					Nails, lbs.				Flux		Crosby Clips			

TRANSFORMERS

Mfgr.	Watts	Number

TIME

	No.	Hrs.	Rate	Amount
Linemen				
Groundmen				
Foreman				
Team				

ELECTRIC METER CARD.

THE CITY OF SEATTLE—LIGHTING DEPARTMENT

Appl. No................ Date of Order....................

INSTALL METER FOR POWER

At...

For...

Meter is required for the following Motors:

No.	Size in H. P.	D. C. Voltage	A. C. Volt.	A. C. Ph.	Remarks
......	....	....	......	......	....
......	....	....	......	......	....
......	....	....	......	......	....

Meterman Fill Out Blanks Below.

Date Installed ....

Meter No................Factory No...............

Make.....................Type..................

Form.................Class......................

Cap'y........Amp....Volt........Multiplier......

Location..

REMARKS

....

....

....

....

....

V. B. 383-2-10-06-1M. **Over**

CARD 8 OBVERSE

MOTORS

Make.......................................Type...........

Size .. ..H. P. Speed... ....Amp...............

D. C. Voltage.................. A. C. Voltage...............

Phase.............Factory No.............................

Owned by.......................... ....City No...........

....

....

Make.......................................Type...........

Size....... ..H. P. Speed................Amp...............

D. C. Voltage.................. A. C. Voltage...............

Phase.............Factory No.............................

Owned by.......................... ....City No...........

....

....

Make.......................................Type...........

Size..........H. P. Speed ....Amp...............

D. C. Voltage.................. A. C. Voltage...............

Phase........ .....Factory o.............................

Owned by...............................City No...........

....

....

MATERIAL USED

....

....

.... | ..... | Hrs. Meterman

.... | ..... | Hrs. Helper....

Signature..

CARD 8 REVERSE

METER CUT OUT CARD

THE CITY OF SEATTLE—LIGHTING DEPARTMENT

Appl. No.............................. Date of Order..................................

CUT OUT METERS

At ....

Owner,...

Tenant,..

LAMPS	4 C. P.	8 C. P.	16 C. P.	32 C. P.	SPECIAL
Furnished					
Returned					

Meter No.................................... Reading.................................K. W.

Meter No.................................... Reading.................................K. W.

.... | ....Hrs. Meterman

.... | ....Hrs. Helper

Signature...

CARD 9

V-B-611

POLE LINE WORK ORDER AND REPORT

CITY OF SEATTLE, LIGHTING DEPARTMENT.

Order No. P. 300 Date________________190__

Build the following Lead:—

No.	Dist.	Length	REMARKS	Hauled	Hole Dug	Pole Set	Steps	Hours Time Date	Foreman	Linemen	Polemen	Teams
1												
2												
3												

CARD 9 A

two or three-wire service, pole, transformer and circuit used.

Meter work cards in addition will have the number and kind of lamps or motors, with the make and number of the meter.

Cut-out cards for both services and meters keep track of material returned and labor necessary in returning it.

We also issue a report sheet to keep track of material used on pole and wire lines.

A customer moves. For the same reason the house number should be recorded on the map rather than the name of the occupant.

Besides the special work order cards for different departments it is convenient to have a miscellaneous work card for line and pole work.

We have found it convenient to issue a separate work order for inside work.

All work orders for outside work are made of strong flexible card.

(To be continued.)

A NEW BUSINESS DEPARTMENT FOR CENTRAL STATIONS IN SMALL CITIES.

By C. E. Stannard.

The working up of the new business of an electric company needs a separate organization in order to be effective. The following scheme is a condensed outline of the organization of such a department, and the subsequent conduct of the completed organization:

The first step in establishing a new business department in cities of 50,000 population and under should be a careful selection of a manager. Among other qualifications, he should be a man of sterling character, having a broad and liberal education; should be versatile and capable of mingling with all classes of people; possessing a thorough knowledge of the electrical business. It is also advisable for him to be well posted on the gas business, thus being able to intelligently meet competition. He should be a man of executive ability and have the faculty of being popular with the public, possessing the ability to manage the employees in his charge.

The city should be divided into ten territories, containing an average of 5,000 people, or 1,250 families. Then subdivide each territory into two districts, one a residence and the other a business. Thus the representatives would have an opportunity of working both classes of trade.

The best plan of compensation for these representatives is that of a certain fixed salary plus a commission, said commission based upon the revenue secured and the value of said revenue. It is recognized that a contract taken, bringing in a certain sum per year, where no expense for construction is necessary, is of greater value to the company than one where a sum equal to the amount received is to be spent for construction work, therefore the first-mentioned contract should pay the representative a larger sum than the latter. In the selection of representatives, it is wise to choose one having necessary qualifications of a power expert. Another should qualify as a sign, window and outlining expert. Another should possess special knowledge pertaining to illuminating engineering. Men thus equipped can assist the other representatives where special technical or expert knowledge is required. Where possible, it is wise for the representatives to be a combination of commercial and electrical engineers. The more knowledge the representatives possess along all lines, the greater the efficiency.

An engineering department can render great assistance to the commercial department by aiding on all large installations of light and power. Their advice is also of value when working on isolated plants, and the two departments should work in unison, one with the other

The salesroom should be planned to show all electrical devices and appliances, with the proper display of the various kinds of reflectors and glassware designed to properly reflect the light. The effect of decorative lighting should be incorporated; a full supply of staple and fancy electric fixtures should be shown; also different forms of display, window and sign lighting. Electric domestic and industrial appliances should form a permanent part of the office display. It might be advisable to have a line of electric motors, desk, ceiling and exhaust fans, and various styles and forms of electric lamps. A dark room should be prepared for the display of electric lighting, for instance, as shown by reflectors, fixtures, etc.

The wiring and fixture department should be maintained by the company, and should work in connection with the new business department. An arrangement of this character increases the efficiency and the value of the work done by the representatives.

The active officers of the company, the general manager, secretary-treasurer, superintendent, chief engineer, commercial manager, heads of important departments, and one or two representatives should meet at regular stated intervals for the purpose of discussing all new business matters. Suggestions for improvement or work of the department should be taken up and discussed, and it will be found that from the varied interests represented in this committee, many new and original plans will be formulated. Furthermore, a spirit of harmony will be cultivated, which will in turn be transmitted to all departments of the company, a most important factor in the conduct of new business work.

Conduct.

A daily morning meeting should be presided over by the business manager, at which time orders should be given and discussed, reports received from the representatives, giving a record of the previous day's work, preliminary reports presented, showing the nature of the proposed day's work. Matters of mutual interest discussed; verbal reports given by representatives of interesting and important contracts closed; thorough discussions of same will result in creating and maintaining interest and enthusiasm. This meeting should be held for a period of one-half hour. It is the experience of representatives attending meetings, as above described, that the time thus spent is of a most profitable nature, and the efficiency of their work has been increased.

Educational meetings should be held each week. Meetings might be presided over by a chairman, and conducted along the lines of parliamentary law. Educational matters should be taken up and discussed, the meeting usually being held for a two hours' evening session. Papers of interest should be presented and discussed. Debates on pertinent subjects should occur. It might be of interest to have two representatives occasionally give an exhibition of how a sale should be made, one acting as salesman and the other as customer. It might be well to incorporate in this work some of the features found in the scientific study of salesmanship, a course of illuminating and electrical engineering, and a thorough study of all principles involved in the supplying of electricity for light and power.

At the office or salesroom the various electrical appliances and devices should be carefully and thoroughly demonstrated. In fact, the last two or three days of each discount period it might be wise to arrange for a competent person to demonstrate electricity as applied to the various domestic uses, showing, among other interesting things, the chafing dish and various electrical cooking and heating appliances. Neighborhood demonstrations can profitably be given in consumers' homes, allowing the consumer to invite a few special friends. The company demonstrator cooking a meal, and using exclusively electrical appliances. In this way very effective advertising may be accomplished.

Demonstration work can be carried a step further by showing at the office electric motors, fans, samples of signs, window lighting and outlining, and various other ways in which electricity is applied. Money spent in demonstration work usually proves very effective and is rarely wasted.

In organizing this department and carrying forward the work, it is found advisable to first make a house-to-house canvass, carefully carding all prospects, upon the completion of which the company possesses itemized and detailed information showing the amount of possible business to be secured. This information, when tabulated, will be found useful and valuable, and is of particular value when the electric company has competition, either in the form of another electric or gas company. When carded, the names and addresses appearing on said cards provide proper lists to be used in sending out advertising.

Representatives should not only be able to take orders, but possess the ability to sell goods. They should canvass all proposed extensions. One of the most important features of their work is the securing of additional consumption from present consumers. All complaint work should be

carefully followed up, and reports made to the office of all poor service, making sure that such service is remedied. Representatives play a most important part in popularizing the company and in lessening of competition. It is important that they watch all new buildings, making sure that all electrical features are incorporated during their construction; that feeds are of sufficient size to take care of lighting other than the interior system; for instance, sign lighting, window lighting, display and outlining. They should visit architects and builders, interesting them in electricity for both domestic and industrial use.

The holding of business already secured is a most important feature of a representative's work. I deem it unwise to ever discontinue any business simply upon the request of a consumer. It will be found in many instances that much business can be held by a representative calling on the consumer. They can aid the advertising work by supplying the one having charge of the advertising with valuable and detailed information.

It is profitable to assign men to work exclusively upon increasing the consumption of present consumers, explaining to them and interesting them in the installation of additional domestic appliances; also decorative lighting and power.

The new business manager should have direct charge of the advertising, changing daily the ads appearing in the newspapers. He should select the souvenirs, possibly conferring with the representatives as to what they believe to be proper and effective ones.

A daily record should be compiled, by the office department, and given to the representatives, showing the appliances and orders taken and complaints registered. Thus he is enabled to keep in close touch with all business transpiring on his territory, whether of a personal nature or coming through the office.

Novel ways for applying electricity include its use for house-cleaning, the mercury rectifier, electro-magnets for maturing coffee, electric machine for cutting dress patterns, arcs for promoting steady and rapid growths of vegetables, arcs over oil tanks for bug extermination, and arc and vacuum for taking and printing pictures.

The representative should occasionally go over his own business territory at night, thus determining where the dark spots are, and seeking to interest merchants in various forms of display lighting. Again, demonstrating to the merchant who has a dark store the value of his neighbors' brilliantly-illuminated windows or stores. Representatives might occasionally go over their neghbors' territories at night, reporting at the next morning meeting suggestions whereby he would seek to improve the conditions found.

Results can and have been secured, more than compensating many companies for the money spent in the new business department. Specifically speaking, through this department, the consumption per kilowatt per inhabitant can be materially increased. This is true, also, of the consumption per consumer, and the consumption per sixteen-candlepower-lamp connected. This department is an important factor in reducing the manufacturing costs per kilowatt; also reducing the costs per kilowatt delivered to the consumers, which necessarily increases the company's profits. The department should be an important factor in increasing the daily load at all times except at the peak, thus lessening the amount of current losses, reducing the cost per kilowatt for manufacture and distribution, increasing relatively the profit.

It is further found that each prospect secured serves to assist in developing new ones. It will further be found that the field is inexhaustible. While in some instances the costs to secure new business the first year seems high, the fact must be taken into consideration that the business thus secured remains with the company for years, and is of no further cost. It is not an unusual thing for a new business department to receive in revenue, the first year, three or four times the original investment.

COPPER MARKET SITUATION.

There have been no large blocks of copper selling in this country lately, and recent business among the local trade has moved slowly, with inquiries on a limited scale, says "Copper Gossip." In the present temper of the market consumers hesitate to buy heavily for future delivery and are waiting for stronger incentives before placing fresh orders. Quotations from first hands are 25¼ for Electrolytic Wire Bars and 25½@26 for Lake brands. There have been frequent rumors and reports of late of lower prices than those above mentioned, but they do not come from any of the leading producers. The effect, however, is confusing and reflects a conflict of opinion in copper circles as to the actual position of the market. The apathy of buyers is therefore not to be wondered at. Consuming requirements will have to be more urgent than at present before buyers will be tempted to pay the prices now quoted for distant futures.

As conditions look to us, it is not a time for manufacturers to add heavily to their stocks unless they are compelled to, and the hand-to-mouth policy is the one that strikes us as the one most consistent with conservative business principles. If the recent unprecedented industrial demand of the country should slacken it would be reasonable to expect that the markets for raw materials generally will find a more normal and, consequently, a more healthy level. A readjustment in the business situation at large would also probably mean a revision of copper prices too. Nothing short of a constant demand up to the full limit of production will be sufficient to keep copper at the present level throughout the entire year. If consumers were able to purchase copper with the price guaranteed not to exceed that in force on dates of deliveries, there would then be decided encouragement to operate every manufacturing plant up to the highest limit of capacity. The initiation of such a plan would be hailed with approval by consumers and its operation prove a strong factor in maintaining steady market conditions.

Production is at a rate requiring a great distribution of copper, and should any accumulation arise market unsettlement would undoubtedly follow. Demand has hitherto prevented unfavorable statistics, but we think the position will be tested in the second half of the year. Under existing conditions the plan of buying months ahead at a flat price involves too great a risk. An enormous consumption is necessary to use up the total tonnage supplied by the mines of this and other countries, and it should be remembered that production is expected to increase.

MOTORS FOR OPERATING VALVES AT THE "KERN RIVER STATION NO. I" OF THE LOS ANGELES EDISON COMPANY.

The electrically operated valve is a mechanical refinement demanded by the size of recent hydraulic and hydro-electric developments, where the necessary control of vast volumes of water requires valve openings which it would be practically out of the question for the station attendants to operate without the application of power. About 120 miles from Los Angeles, California, in the canyon of the Kern River, a new power house, being completed by the Los Angeles Edison Company, is ready to supply electric power to the city from 43,000 horsepower in Allis-Chalmers horizontal water wheels. The power plant will be equipped with valves electrically operated by means of eight type "K" Allis-Chalmers direct current motors. They will be used on 28-inch gate valves built by the Risdon Iron and Locomotive Works, of San Francisco. These motors are of the vertical type, series wound, 4 horsepower each. They are totally enclosed, and so arranged that they may be controlled directly from the power house.

Electrical Construction for the Architect

TELEPHONE WIRING.

The wiring of large buildings for telephone connections requires both judgment and experience, so as to insure safety and to further convenience of installation and extension.

The "Journal of Electricity, Power and Gas" is in receipt of a request for information as to the provisions necessary in modern buildings. The Pacific Telephone and Telegraph Company has provided an outline of instructions for the use of architects. The information, the company's engineers explain, is based on practical experience of the American Telephone and Telegraph Company, of New York, where the telephone has attained its highest development.

In the wiring of hotels and apartment houses, it may be figured that one telephone will be required for each hotel room, and one for each apartment. In office buildings, it is not possible to figure so closely, since several telephones may be required for a single office, while the location of telephones in the rooms is liable to change, at the option of tenants. A much more flexible system, thus, must be provided.

In hotels, a telephone switchboard is located at some convenient point, usually on the ground floor. Telephones are placed in each room or apartment and wired to this switchboard, which is connected by one or more trunk lines with the nearest exchange of the telephone company. The wiring problem is, therefore, comparatively simple, involving the running of a pair of wires from some definite point in each room or apartment to a common center near the switchboard location. Provision should also be made so that the telephone company can run its trunk wires from the switchboard to the point at which the telephone cable enters the building from the street, usually in the basement. A two-inch conduit is usually sufficient for this purpose.

One of the simplest and cheapest methods of wiring buildings of this type is as follows:

A terminal box is placed upon each floor, at some central point convenient to a vertical pipe shaft. From this terminal box a ⅝-inch conduit is run to a designated location in the wall of each room in which a telephone is to be placed. The height of the outlets in each room should be four feet ten inches from the finished floor, this having been found to be the most satisfactory height to place the telephone. This conduit should not be over fifty feet in length, nor have more than three bends with a minimum radius of five inches. Any conduit 100 feet in length should not be less than one inch in diameter. Five-eighths-inch conduit should be provided for a maximum of two pairs of wires; three-quarter-inch conduit for five pairs; and one-inch conduit for ten pairs. In extending conduit from terminal boxes to rooms it is possible in many cases to use one run of larger conduit to supply three or four rooms, rather than run smaller conduit to each individual room. When the floor area and the number of rooms is large it may be found economical to have more than one terminal box on a floor.

From the common center, i. e., where the telephone switchboard is placed, a cable is run through the vertical pipe shaft adjacent to the boxes. The size of this cable diminishes as it extends up through the building. At each box a tap is terminated of sufficient size to provide wires for all telephones on that floor. At the common center, near the switchboard, this cable, or, in very large buildings, several cables, is terminated so that connection can be made with the switchboard. The best point for this terminal is directly back of the switchboard location. From the terminal boxes on each floor, twisted pairs of rubber insulated wire are run through the conduits to locations in each room.

In apartment houses, where only one telephone per apartment is required, a simple method of wiring is as follows: A vertical conduit is extended up through each tier of apartments, and an outlet provided in each apartment. Individual pairs of twisted rubber-covered wire can then be pulled through this conduit for each telephone. The individual wires can be carried in a cable from the bottom of the risers to the switchboard location. Of course, this system requires that the telephone location be the same in each apartment supplied from the same riser.

In large office buildings the service cables from the telephone exchange are usually terminated at some convenient place in the basement. Wiring the building for telephone service, therefore, consists in carrying a number of pairs of wires from each floor to this point. The number of wires to be provided for each floor will depend largely upon the size of the building and the class of business for which it is to be used. A rough average is one pair per 200 square feet of floor space in the financial district, and 300 square feet in the commercial districts. The most economical and satisfactory system of telephone wiring for large office buildings is believed to be the following:

One or more terminal boxes, depending upon the size of the building, are provided on each floor at points adjacent to vertical pipe shafts. Elevator shafts can frequently be used for this purpose. From the basement one or more cables are extended up through these shafts. Branch taps of sufficient size to provide for service on each floor are terminated in the terminal boxes. These riser cables and the service cables from the telephone exchange should terminate in a common main terminal in the basement, so that connections can be made easily between the two sets of cables. The terminal boxes should be placed near the ceiling, and wide shell moulding should be provided in the halls for carrying the wires from the terminal boxes to the rooms. A smaller moulding should also be provided in the individual rooms for carrying the wires to the particular location desired.

Where the wires enter the room from a hall, a piece of three-quarter-inch conduit should be furnished for carrying the wires through the partition. The conduit should either be lined with insulating material or the sharp edges around the inside of the pipe rounded off.

Where it is necessary to run across the ceiling of a hall in order to avoid either carrying the exposed wires across the finished ceiling or making a circuitous run around the hall to reach the rooms on the opposite side from the floor terminal, conduit should be installed across the ceiling before the plastering is completed, for the purpose of carrying a small branch cable to provide for such lines.

In a number of cases it has been the practice of engineers to specify rubber-covered cable for wiring buildings for telephone service. This work can be done much cheaper and better by the use of lead-covered, paper-insulated cable, such as is used by the telephone company in its subways. These cables are smaller for the same number of wires, and are less costly than cables containing wires with rubber insulation. Paper cables less than three inches in diameter, and containing as many as 600 pairs of wires can be obtained. Of course, with this type of cable, all of the terminals of the cable or its branches must be made with lead-covered, silk and cotton-insulated cables, as the paper insulation will not stand handling when exposed. Where the terminal is in a damp location it should be made with rubber-insulated wire. Shafts are much preferable to iron conduit for carrying the main riser cables, as it is difficult to make the splices between the riser cables and the floor terminal cables if the former are run in conduit.

APPROVED ELECTRICAL FITTINGS.

This department from time to time will contain an illustrated description of all fittings approved by the Underwriters' National Electric Association.

CABINETS.

Le Manquais, Style A, Cabinets for metal conduit systems. Approved March 5, 1907.

H. T. Paiste Co., Philadelphia, Pa.

N. E. Mfg. Co. slate, sheet-iron gutter, oak front, glass door. Approved January 29, 1907. Manufactured by

The Newport Mfg. Co., Newport, Ky.

Spranley & Reed. A pressed steel switch box or service cut-out cabinet. Approved Feb. 7, 1907. Manufactured by

Spranley & Reed, New Orleans, La.

CABLES, ARMORED.

Sterling. Approved April 3, 1907. Manufactured by

Sterling Conduit Co., Troy, N. Y.

CONDUIT BOXES.

G. E. "Adjustable" and "P. R." water-tight, floor outlet boxes. Cat. Nos. 76,471 and 76,459. Approved Jan. 31, 1907. Manufactured by

General Electric Co., Schenectady, N. Y.

"Simplex" floor receptacle or box. No. 3000, 3 A, 250 V. Cast-iron box, with brass floor plate and cap. Approved February 18, 1907. Manufactured by

Stanley & Patterson, New York.

Sprague, Cat. Nos. 6234 and 6235, for armored cable. Approved January 22, 1907. Manufactured by

Sprague Electric Co., New York.

Harveyduct and Interiorduct. Approved Feb. 7, 1907.

H. A. Petersen Mfg. Co., Harvey, Ill.

Sterling flexible steel conduit. Approved April 3, 1907. Manufactured by

Sterling Conduit Co., Troy, N. Y.

CURRENT TAPS.

Connecttones. Approved Feb. 18, 1907. Manufactured by

The Dale Company, New York.

CUT-OUT BASES, CARTRIDGE FUSE.

"B. P." All capacities, 25 volts, porcelain and slate bases. Approved March 2, 1907. Manufactured by

Briner-Pogue Mfg. Co., St. Louis.

"Noark," standard type, all classifications, 250 and 600 V. Approved Mar. 4, 1907. Manufactured by

The Johns-Pratt Co., Hartford, Conn.

The H. W. Johns-Manville Co., New York, Sole Agents.

"Sachs" (formerly "Arknot"), porcelain and slate bases, all capacities, 250 and 600 volts. Approved March 4, 1907. Manufactured by

The Sachs Company, Hartford, Conn.

CUT-OUT BASES, EDISON PLUG.

G. M. & S. Co., porcelain bases, 0-30 A., 250 V., all types. Approved Feb., 1907. Manufactured by

General Mfg. & Supply Co., Trenton, N. J.

Holabird, Reynolds, 0-30 A., 250 V., double pole, main to branch circuit, porcelain cut-out, Cat. No. 1935. Approved Jan. 29, 1907. Manufactured by

Holabird-Reynolds Co., Los Angeles, Cal.

FLEXIBLE CORD. Portable for Electric Heaters.

"American." Double conductor cord composed of braided conductors with rubber and asbestos coverings, protected by woven cotton braid. Approved Jan. 22, 1907.

American Electric Heater Co., Detroit, Mich.

FUSES, CARTRIDGE ENCLOSED.

"Noark." Standard type, all capacities, 250 and 600 V. Approved March 6, 1907. Manufactured by

The Johns-Pratt Company, Hartford, Conn.

The H. W. Johns-Manville Co., New York, N. Y., Sole Agts.

"Sachs" (formerly "Arknot"). All capacities, 250 and 600 V. Approved March 4, 1907. Manufactured by

The Sachs Company, Hartford, Conn.

FUSES, PLUG.

"Noark." Standard type, renewable, 0-30, 31-60 A., 250 V. Approved March 5, 1907. Manufactured by

The Johns-Pratt Company, Hartford, Conn.

The H. W. Johns-Manville Co., New York, N. Y., Sole Agts.

HANGERBOARDS, ARC LAMP.

G. E. Cat. No. 36,844, equipped with 250 V., enclosed cartridge fuse cut-out. Approved April 9, 1907. Mfd. by

General Electric Co., Schenectady, N. Y.

HEATERS, ELECTRIC.

Barr Electric Flat-Iron Co., Cat. No. 9216. Type 2 A., 4.8 A., 110 V. Approved Feb. 4, 1907. Manufactured by

W. J. Barr Electric Mfg. Co., Cleveland, Ohio.

Johns-Manville Type H, Heater No. 1, 110 V. A group of heat coils encased with perforated sheet metal and supported on iron legs. Supplied with regulating switch and approved heater cord for portables, for use on circuits supplying up to 5000 watts. Approved Feb. 18, 1907. Mfd. by

The H. W. Johns-Manville Co., New York, N. Y.

INSULATING JOINTS.

T. & B., four-prong insulating stud for straight electric fixtures. Approved March 16, 1907. Manufactured by

The Johns-Pratt Co., Hartford, Conn., for Thomas & Betts, New York, N. Y.

LAMP ADJUSTER.

"Ideal." A cord running in a groove in special porcelain ceiling block and at one end supporting single lamp socket by action of a weight hanging from other end of cord. Approved April 9, 1907. Manufactured by

Trumbull Electric Mfg. Co., Plainville, Conn.

Morse. Approved Jan. 7, 1907. Manufactured by

Frank W. Morse, Boston, Mass.

LAMP CLUSTERS.

Benjamin, porcelain bases and rings, multiple, fibre-lined, types 1, 2, 8, and K. type 7 with 250 V. snap switch. Series type 1½ and 2½, Edison bases, marked "series connected." Multiple or series, type 600. Approved Jan. 3, 1907. Manufactured by

Benjamin Electric Mfg. Co., Chicago, Ill.

G. E. All porcelain, wireless, two, three, and five-light types, both "Multiple" and "Series" connected designs, Cat. Nos. 40,517-40,522. Approved April 9, 1907. Mfd. by

General Electric Co., Schenectady, N. Y.

LAMP GUARDS.

"Hold Fast" wire lamp guard for incandescent lamps. Approved March 4, 1907. Manufactured by

Hold Fast Lamp Guard Co., St. Louis, Mo.

MOULDING.

Jordan Splice Protector. A porcelain block for branch in moulding line, 2 or 3 wire. Approved Jan. 3, 1907. Mfd. by

Jordan Bros., New York, N. Y.

"Lutz" metal moulding with metal fittings and junction box. Approved Jan. 15, 1907. Manufactured by

The American Circular Loom Co., Chelsea, Mass.

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POWER AND GAS
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Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," with which is incorporated "The Engineers', Architects' and Builders' News."
Entered as second-class matter at the San Francisco Post Office, August 15, 1899.
Entered as "The Electrical Journal," July, 1895.
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VOL. XVIII MAY 4, 1907 No. 18

EDITORIAL.

Recording, Filing and Using Engineering Data

For the engineer, data which yesterday was of great value may be of little use today, and, therefore, not available in its original form for application to present problems. For this reason text and reference books in engineering are not of the same value as are corresponding books in the field of pure science, law, literature or history. Notwithstanding the fact that changes are almost daily occurring in engineering practice, accurate and carefully selected data, no matter how old, is a necessity to the engineer in his work. General principles of design and construction remain the same, but the capacity, method of operation, and especially the cost of manufacture and construction of all machinery is subject to continuous and progressive modification.

The engineer who depends upon his memory for engineering data is certainly burdening his mind unnecessarily, and it is rare indeed that a man, no matter who he may be, can retain in sufficient detail for application data and information that comes under his observation but a single time. It is also quite impossible for the engineer to in every case remember the book or periodical in which he has seen the specific data desired at any particular time.

For this reason some form of card catalogue is found most useful to the engineer. By using cards, one of which will be used exclusively to contain the subject of the article or reference, and a brief outline of the scope of the treatment of the subject, it is possible to make available in a moment's time and with little effort, a great fund of information which is not only valuable but is a necessity for the engineer in the treatment of the many different problems requiring his attention.

A card catalogue system, however, may be so elaborately planned as to require the entire time of one man to keep it up, when in reality the card catalogue is supposed to be a saver of time. The above may be considered an extravagant statement, but when one examines many proposed card catalogue systems, it is evident that very little time will be left to the engineer who gives his personal attention to the work of making and transferring records for future reference. Duplicate and triplicate cards are, of course, necessary in order to provide cross references to cover alphabetical arrangement, grouping of subjects under common authors, and the compilation of all data pertaining to a given subject. The card catalogue system which can be put into a small space, is readily accessible and contains only sufficient data to indicate the location of the original information, is the happy medium, which is rarely found in reference schemes.

The most important records from the standpoint of the engineer are those relating to the costs of machinery, its installation and general construction work. In using such records it is to be remembered that using the costs of other work independent of the conditions existing on the particular work under consideration, especially as related to raw material and labor, may lead to disastrous conclusions in the preparation of estimates for the similar proposed new work. It is, therefore, quite necessary in such cost indices to supplement the data in every case with additional information which will be needed to adapt the figures to other work. It is not possible, as in the determination of probable economy or efficiency, to use the average cost of a number of similar instances of work, unless the conditions are practically the same.

Large manufacturing companies recognize the necessity of keeping engineers informed regarding the progress and advancement in the different lines of machinery manufactured by them. For this reason

bulletins, each copy being a part of a series, have largely taken the place of the old, bulky catalogues. Many of these bulletins are of value to the engineer and contain important data. Upon receipt of the bulletins the recipient is confronted with the problem of satisfactorily filing them away for future reference, so that they may be available when required. Everyone who has had experience with the preservation of these bulletins and catalogues has probably been dismayed and bitterly disappointed because of the amount of time and space required to preserve them in some manner so that they may be easily found when needed.

In this connection not the least discouraging feature is the fact that in all probability by the time the group of catalogues and bulletins is sufficiently large to cover much ground, a large portion of the bulletins are out of date and practically valueless.

For reports, correspondence and information of a complete nature, there is probably nothing so convenient and satisfactory as some form of vertical filing device, wherein the paper used for every purpose is of the same size. Where it is necessary to preserve drawings and blueprints, it is usually necessary to fold them so that they may be put in an envelope, properly marked and similarly filed in a vertical cabinet, in the same manner as reports. It is, of course, many times undesirable to fold drawings or even blueprints, but if any number are to be preserved in a compact space, no other plan is so satisfactory.

At the present time each individual interested in compilation and preservation of records seems to have his own system, which, in most instances, is independent of and different in character to the system used by anyone else. It must be admitted that in most cases the systems which have been thoroughly worked out and have from time to time been proposed in the technical press are so elaborate as to break down and be rendered useless on account of the enormous amount of work required to keep them in a reasonable state of completion.

The ultimate result will probably be to divide card record systems into two classes. The first class shall be brief and small in its extent, primarily for the use of the individual who himself keeps the card record system up to date and complete. The second system will be the more elaborate one, which is used by a larger number of individuals where it is possible to have all of the work of the card catalogue system in the hands of some one person, whose time may be largely or wholly required for the work of the maintenance and detail of the scheme.

ELECTRICAL CONSTRUCTION FOR THE ARCHITECT.

With this issue we inaugurate a new department of electrical construction for the architect and contractor. Under this caption we will endeavor to give in as concise a form as possible such valuable information appertaining to interior wiring for electric lights and telephones, gas piping of buildings, and a description of such electrical apparatus as has been approved by the Underwriters' National Electric Association.

These articles will be independent of all favors to the manufacturer.

The article on "Telephone Wiring" is of especial interest in the rebuilding of San Francisco, and is to be followed by others of like interest. Any questions submitted to this department will receive careful attention.

The list of approved electrical fittings includes all apparatus that has passed the Underwriters' National Electric Association since the first of January of this year. Hereafter it is to be illustrated.

PERSONALS.

Frank Fowden, manager of the Brooks-Follis Electric Corporation, has left for a six weeks' trip throughout the East.

Stanley Walton has been appointed manager of the commercial department of the California Gas & Electric Corporation.

Van Rensselaer Lansingh, engineer and general manager of the Holophane Glass Co., of New York, together with Charles A. Howe, general sales manager and A. J. Marshal of the engineering department, have been in San Francisco during the past two weeks in the interests of the Holophane Company. A branch supply house has been established in San Francisco. Mr. Lansingh has the distinction of being the first upon whom the title of illuminating engineer was conferred. Since 1901 the profession has grown until to-day it is one of the most important branches of architectural engineering.

H. P. Pitts has resigned as commercial agent of the California Gas & Electric Corporation, and will join the staff of the Great Western Power Company on May 1st.

L. W. Stocker is in the engineering department of the California Gas & Electric Corporation.

Ralph L. Phelps has severed his connection with the Telephone & Electric Equipment Company, and, after May 1st, will be the advertising representative of the "Mining & Scientific Press."

The American Supply Company has opened a sales room at 1055 Howard Street, San Francisco, where they have a large supply of electrical apparatus and sundries. In addition they carry a line of boilers and radiators for buildings.

The Electric Railway & Manufacturing Supply Company, of San Francisco, is moving from its temporary quarters, occupied soon after the fire, to 84-86 Second Street. The new salesrooms afford opportunity to display to advantage its large stock of supplies, ready for immediate delivery. Material on hand includes a large shipment of Trumbull switches, as well as all manner of telephone equipment.

INDUSTRIAL

THE ELECTRICAL INSTALLATION OF THE PROVIDENCE LITHOGRAPH COMPANY.

One of the most interesting electrical installations in Rhode Island is the power and lighting equipment of the Providence Lithograph Company, located on Prairie avenue, at the corner of Reynolds avenue. All the machinery is electrically driven, in most cases direct-connected motors being used. Power is supplied by the Narragansett Electric Light Company, of Providence. In every particular the installation bears the mark of careful designing and excellent construction. In its adherence to the direct rather than the group drive, the plant is a typical instance of the latest practice.

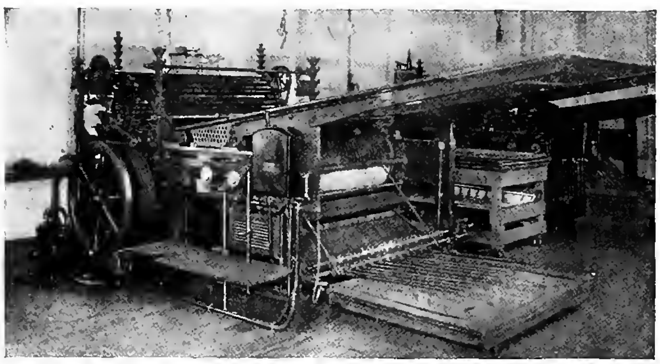


FIG. 1.—MOTOR-DRIVEN LITHOGRAPH PRESS.

The building is a one-story brick structure, consisting of a workshop section, 300 feet wide by 100 feet long and an office 100 feet square. In order to provide a solid foundation for the heavy machinery, the floor in the press and cutting rooms was built of ⅞-inch maple planks laid on 3 inches of hemlock, the latter resting on 6 inches of concrete. No vibration is apparent when the machines are in operation. Beneath the floor of the work room on the Reynolds avenue side of the building is a fire and moisture-proof vault for the storage of lithograph stones and plates. This vault is divided into sections, each section being lighted by two 16-candlepower, 250-volt lamps, so that any plate or stone can be quickly found in its numbered compartment. The temperature of the vault is kept at about 70 degrees F. by steam heat, it being essential for the proper storage of the stones that no moisture be allowed to gather upon their surfaces. The building is lighted by 250-volt incandescent lamps, supplemented by enclosed arc lamps for general illumination. The current supply for the lighting circuits is single-phase. The lamp and switch fittings in the vault are of the marine type. The switches are operated by pendant cords of non-conducting material so that there is no danger of shock in case an outside line becomes crossed. About 200 16-candlepower incandescent lamps are in service. The quality of work in the plant renders good lighting of the first importance; the larger part of the company's output consisting of colored illustrations for religious and secular educational work. Abundant natural light is, therefore, provided by saw-tooth skylights admitting north light and numerous large windows. In addition the interior walls are painted white.

All the motors are of the direct-current type, and operate at a potential of 500 volts. Motors rated at one-half horsepower or less are of Holtzer-Cabot type "E" design; larger motors are of type "SE" design, characterized by extreme shortness along the shaft axis, and by large startinfi torque. The result is a very narrow motor, which in many cases can be set inside the floor area occupied by the driven machine and installed so that no part of the motor projects into the aisle space. The compactness of this motor can be seen in the accompanying illustrations of lithographic presses and cutters, comparing the size of the motor with the driven machine. The motor wiring is carried in iron conduit. Special care was taken to avoid introducing shadows caused by installing wires between the machines and the skylights.

The service wires are brought in on the Reynolds Avenue side of the building. The entering cables are carried in iron conduit through and down the wall to the floor and thence to

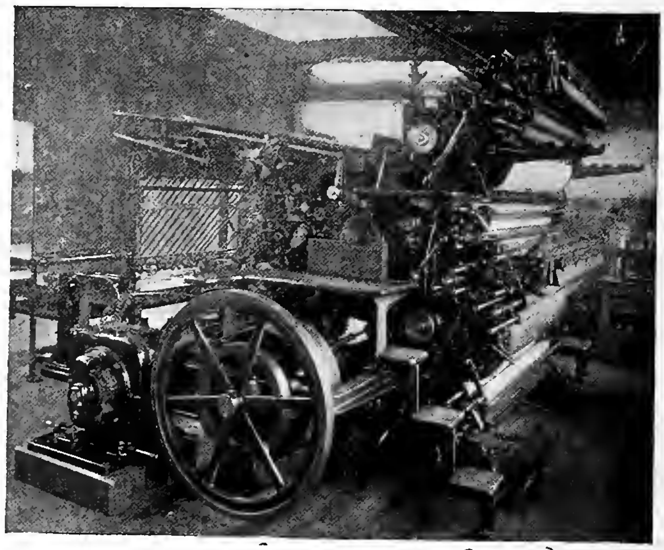


FIG. 2.—MOTOR-DRIVEN LITHOGRAPH PRESS. THREE-COLOR.

two switchboard panels set up in one corner of the cutting room. The motor service is of No. 2 wire and the lighting service of No. 4 wire. The service boards are of slate, separately mounted. One is given up to motor service and is 32 inches high, 30 inches wide and 1½ inches thick. The lighting panel is of the same dimensions. The panels are mounted 12 inches apart, with a clearance of 24 inches between the panels and the nearest parallel wall. Terminal connections were specified for a minimum capacity of 100 amperes per square inch. Each panel is equipped with ammeters, a recording watt-hour meter and the usual knife switches and enclosed fuses. All mains larger than No. 7 wire are held taut by strain insulators on runs of 50 feet or more, straightaway. Motor-starters and controllers are placed within easy reach of each operator. On the presses the controller resistance is detached, and push buttons are provided, one at the head end and one at the opposite side of each press, for stopping the presses quickly. Motors placed on the floor are set over zinc pans.

There are about thirty motor-driven machines in the plant, which is divided into a pressroom and a cutting room section, with sub-departments in addition. In the pressroom are seven direct-driven lithograph presses. One is a tri-color press, giving 1,200 impressions per hour. This is direct-driven by a 5-horsepower motor. The speed of the motor ranges from 700 to 1,000 revolutions per minute, and full load current is 8 amperes. The motor is capable of 100 per cent. overload temporarily, in starting and "inching" with the

brushes fixed. All the press controllers are arranged to give two reverse speeds and are fitted with four armature resistance points for use in forward starting and ten field points for running at different speeds. A novel feature of the control is the use of a variable resistance in parallel with the series winding for speed regulation, in place of the usual variable resistance in the shunt field circuit. No external armature resistance is used in regulating the speed, but the entire control is effected by the variable shunt around the series coil. In driving presses constant speed for any given class of work is important, and the arrangement of altering a resistance in parallel with the series turns was introduced by Mr. Kelley's specifications as a better means of obtaining uniform control than the older plan of weakening the shunt field. It is

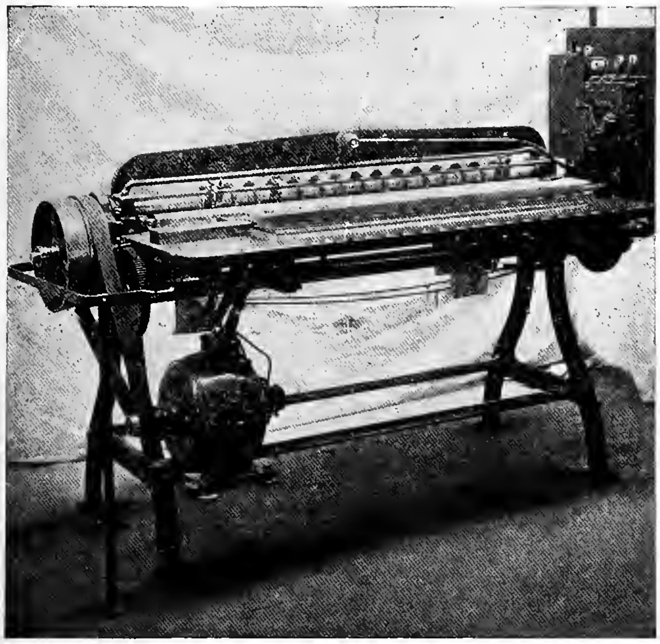


FIG. 3.—MOTOR-DRIVEN COLLATOR WITH PUSH BUTTON STOP

undesirable to apply a motor having the characteristics of a series-wound machine to a press, on account of the variation of speed with load, and the plan of shunting the series coil makes the motor act more and more like a pure shunt motor as the shunt around the series coil is made of less and less resistance. Each starting box is equipped with a no-voltage release and has sufficient resistance to start the motor from rest at full load without exceeding 1.75 times full load current. All the controllers are designed so that the attendant cannot get a shock in handling them from any point about the presses. A recent test of the motor driving the tri-color press showed a current consumption of 5 amperes on the first running point, the speed being 625 revolutions per minute. On the last running point the motor was making 900 revolutions per minute, the current being 7 amperes. A two-color press is direct-driven by a 3.5-horsepower motor, having a speed range of from 700 to 1,200 revolutions per minute. This press will easily make from 1,000 to 1,600 impressions per hour maximum. The motor has a full load current of 6.25 amperes and an overload output of 7-horsepower. In a test of the power consumption of this press the motor took 4.1 amperes, the press making 720 impressions per hour and the motor speed being 625 revolutions per minute. On the first speed point of the controller (second running point) the motor took 4.4 amperes, the press making 900 impressions per hour, and on the second speed point the motor consumed 4.5 amperes, 1,000 impressions being run off the press.

Five single-color presses are each driven by a 2.5-horsepower motor, the full load current of which is 4.54 amperes. These presses have a maximum capacity of 1,800 impressions per hour. In a test on one of these presses the motor consumed 3.4 amperes on the first running point, 1,260 impressions per hour; 3.7 amperes, fifth running point, 1,440 impressions, and 4.4 amperes, eighth point, 1,620 impressions.

Another representative test on a straight lithographic press of the same make gave the following results:

Running Point.	Amperes.	Impressions Per Hour.
1	3.4	1,160
2	3.5	1,200
3	3.6	1,320
4	3.7	1,380
5	3.9	1,440
6	4.1	1,500
7	4.2	1,560
8	4.3	1,620
9	4.4	1,680
10	4.5	1,770
11	4.6	too fast

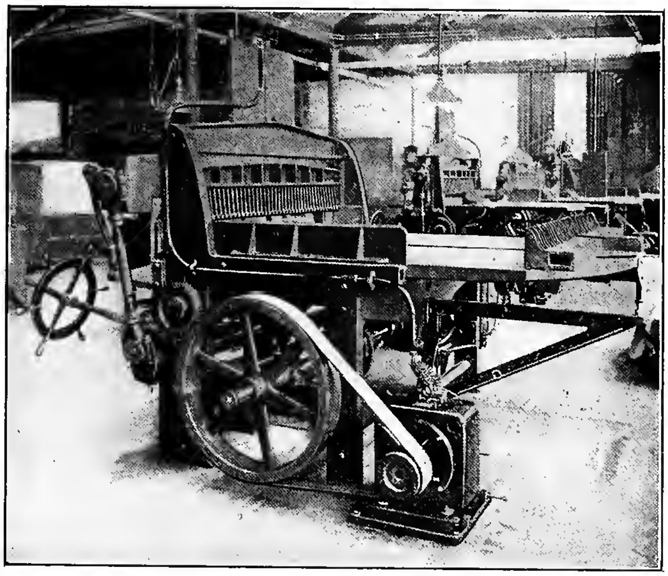


FIG. 4.—MOTOR-DRIVEN PAPER CUTTER.

On the five single-color presses mentioned, the motor overload output is 5.5-horsepower. An interesting feature of the press equipment is the arrangement of a tell-tale signal on the wall behind each press to show when a press is over or under-speeded. In each controller is a contact which the foreman sets at the proper speed for each job, and if the operator changes the speed two lamps on the wall are lighted, showing the foreman that something is wrong. The device is of considerable importance in keeping the production of each machine at a maximum. Each controller is fitted with an overload release and each motor with a dynamic brake, which short-circuits the armature when current is cut off from the motor, bringing it to an immediate stop.

The plant contains one 42-inch by 64-inch bronzing and one dusting machine, both of which are driven through belt and line shafting by a 3-horsepower motor running at a speed of 1,025 revolutions per minute. There is also a small washing machine in this equipment.

The cutting room contains a large assortment of machinery. There are two 60-inch paper cutters, each of which is direct-driven by a compound-wound, 3.5-horsepower motor, whose speed is 1,200 revolutions per minute.

The full-load current of the motors is 6.2 amperes. On a test of one of these, the motor took 2.1 amperes with the cutter running free on the shaft and fly wheel and 6½ amperes average, making a heavy cut of paper. The range of the ammeter needle was 5.7 amperes.

Two 50-inch paper cutters are also in service, each direct-

driven by a 2-horsepower compound motor, with 3.6 amperes full load current and 1,200 revolutions per minute motor speed. In a test on one of these cutters 2.4 amperes were required to cut stock 36 inches wide and 1¾ inches thick, and 3 amperes for 36-inch by 2⅞-inch stock. Running free with shaft and fly-wheel the cutter required 1.4 amperes. In this department are also one tube machine with a 36-inch roll, driven by a 1-6-horsepower motor; an embossing press driven by a 1½-horsepower motor of 725 revolutions per minute normal speed; three wire stitchers, each driven by a 1-6-horsepower, 1,200 revolution per minute motor; one folding machine driven by a ½-horsepower motor; a circular saw driven by a 3½-horsepower, 1,500 revolution per minute motor; two cutting-out presses, each driven by a 1-horsepower, 600 revolution per minute motor; three collators, each direct-driven by a 1-6-horsepower, 400 revolution per minute motor, and a large collator, driven by a ½-horsepower, 600 revolution per minute motor at a speed of 3 revolutions per minute. The last machine is extremely useful in enabling the different lithographs in a series to be placed in order for binding. A vertically-revolving wheel contains fourteen carriages, twelve

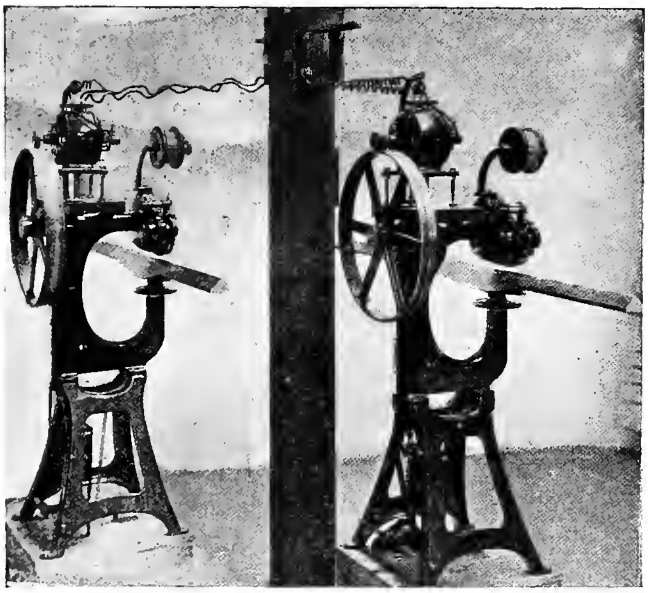


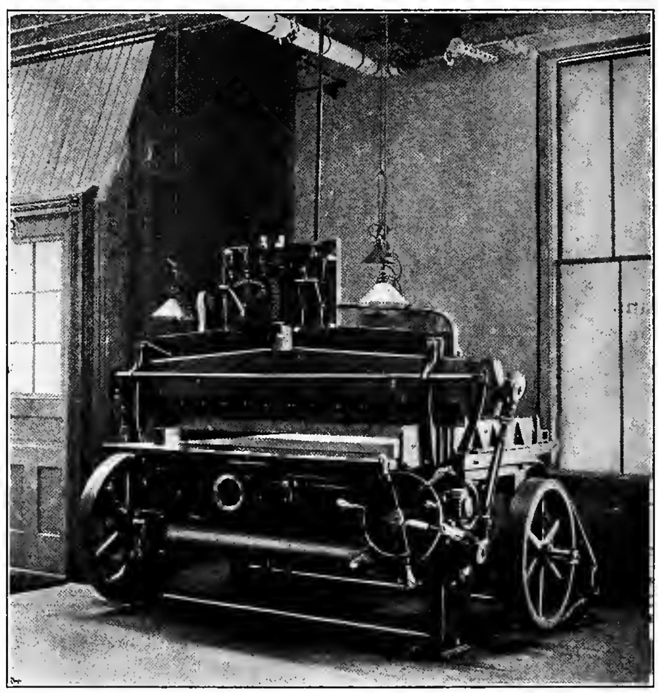
FIG. 5.—WIRE STITCHING MACHINES, FOOT CONTROL.

for illustrations and binding. On each carriage is a pile of similar lithographs, and as the wheel revolves an operator picks one sheet off each carriage in the order of rotation, so that at every complete revolution of the wheel a complete set is collated. The three collating machine motors are each built in a ½-horsepower frame and wound for 1-6-horsepower to give the slow speed required, 400 revolutions per minute. These and the wire stitcher motors are shunt-wound machines. The development of such small shunt motors as 1-6-horsepower on 500 volts is one of the notable things of this interesting plant. There is also in this room a knife-grinder driven direct by a 3.5-horsepower motor, making 1,200 revolutions per minute. The plant has in addition three graining machines and a stone planer group driven by a 3.5-horsepower motor, and a lithographic hand press driven by a 1-horsepower motor. In one section of the workshop is a stock room, in which is an ink mill driven by a 7.5-horsepower motor. The mill is used in grinding inks and is a notable time saver.

In one portion of the shop a room for photographic work is being fitted up, and to enable pictures to be taken on dark days or at night two 30-volt, 25 amperes, automatic photo-engraving arc lamps, built by C. J. Bogue, of New York City, are installed. The entire plant is equipped with automatic sprinklers of the Grinnell type.

In the design of a motor-driven plant it is often difficult to estimate correctly the time a machine is in actual operation. The owner often believes his machinery to be in service a much longer time than is the case. As a matter of fact, it is frequently found that a machine to be used in a specialized industry is not in use more than 25 per cent of the year. In this particular case the estimates of the designing engineer were based on partial power tests, and the statements of the lithograph company as to the time it thought the various machines would be in operation. These data as modified by the judgment of the designing engineer, resulted in a tolerably close estimate of the use of current. The great advantage of the direct drive in using power only when the driven machine is at work is plain from his figures of estimated hours' use per month for the following machines:

Ink mill	100	47
Bronzing machine	75	35
Cutting-out machine	80	38
Knife grinder	50	24
Embossing machine	80	38
Circular saw	100	47
Graining machine	150	71
Collating machine	200	94
Mailing tube machine	150	71
Stitching machine	150	71
Transfer presses	50	24
Oswego cutter	75	35
Rotary press	105	49
Lithographing press	116	55
Combination press	86	41
Two-color press	150	71
Three-color press	120	57



MOTOR-DRIVEN PAPER CUTTER, SHOWING METHOD OF WIRING FOR CONVENIENT STARTING.

The estimated maximum energy consumption in kilowatt hours for the plant as installed was 3,566, and the minimum 2,559. The actual figures for the first four months were: February, 3,090; March, 2,680; April, 2,740; May, 3,300 kilowatt hours, the average being 2,952 kilowatt hours.

The plant is owned and operated by Messrs. Harris, Jones, & Co., of Providence. The liability insurance inspector pronounced it "the best arranged, most complete and satisfactory" from a liability standpoint of any that he had examined.

The architects for the building were Messrs. Lockwood, Greene & Co., of Boston, and the installing electrical contractors were Lindsley & Allen (Inc.), of Providence. All the motors were supplied by the Holtzer-Cabot Electric Company, of Boston (Brookline Station), and the controllers by the Cutler-Hammer Company, of Milwaukee. The lighting equipment was furnished by the General Electric Company through the Narragansett Electric Light Company, and the designing engineer for the installation was Mr. Walter Stuart Kelley, now chief engineer of the Holtzer-Cabot Electric Company. Mr. J. H. Smith, one of the firm, is superintendent of the plant.

A NEW PORTABLE COMBINATION METER.

The unique combination of a voltmeter, ammeter, wattmeter and horsepower meter in one instrument, is accomplished in the "Victor" Combination Meter, manufactured by the H. W. Johns-Manville Co. This instrument was first placed on the market somewhat over a year ago, and, from the large number of inquiries and orders received, it has evidently filled a long-felt want.

It was first designed for switch-board use in central stations, and the success of the instrument for this purpose has recently led to the placing on the market of a portable form for general electrical testing, an illustration of which appears above.

The "Victor" meter consists of two separate and complete instruments in a single case, the one giving readings in volts and the other in amperes. The third and fourth readings are obtained on a scale plotted at the center of the dial, giving the product, or power consumption, in watts or kilowatts and horsepower. These readings are taken at the points of intersection of the two indicators. The power

scale is calibrated in "watts" or "kilowatts" on one side and "horsepower" on the other.

The convenience of having in one instrument a portable meter giving readings in volts, amperes, watts and horsepower is readily appreciated at a glance, as this meter is adapted for rapid testing in the laboratory, while for field work it is almost indispensable. It has been found especially suitable for taking readings on electric cars, electric elevators, etc.

If desired, multiple shunts and extra multipliers will be furnished in connection with the volt and ampere scales for additional readings, and a table, containing the multiplying factor to be used with these various combinations, when reading the central scale.

The workmanship and materials used in the manufacture of the "Victor" meter are of the highest class. The calibrations are carefully and accurately made, and the instrument is reliable and permanent.

TRADE CATALOGUES.

Bulletin No. 1057 from Allis-Chalmers Co., introduces their type "K" motors, which supersede types "N" and "B" d. c. motors, that can be applied either to the individual or group drive of machinery.

PRESERVATION OF WOODEN POLES.

Experiments made by the Austrian telegraph authorities in the preservation of wooden poles will interest American engineers. Until recently all the telegraph poles used were prepared by impregnation with copper sulphate. This process gave very good results for some years, especially in the case of new lines, but it gradually became apparent that in the case of older lines the necessity for replacement of poles became more and more frequent—the life of a pole being reduced to only two or three years. The cause of this has been proved to be the presence of fungi which, in course of time, infest the ground around the old poles, and then rapidly attack the new ones. Experiments in various directions were undertaken, and attention was directed to the Bethell process for impregnating wood with creosote. By this process pine wood can be made to absorb as much as 300 kilogrammes of oil per cubic meter of wood. The cost of this large quantity of oil, together with that of the special apparatus involved, add largely to the expense of preparing the poles, whilst the fact that the oil oozes out and overspreads the surface makes the handling of poles treated in this way inconvenient and difficult. To avoid these difficulties, other processes have been devised by which a much smaller quantity of oil than the maximum which the wood can absorb is forced in Rutger's process, for instance, is similar to the Bethell process, but after the wood has absorbed about 100 kilogrammes of creosote per cubic meter the action is stopped. The remaining oil is then withdrawn and superheated steam admitted, which drives the oil into the interior, and at the same time dries the surface. In this way the cost of preparation is little more than for the far less effective copper sulphate impregnation. Poles treated in this way and erected in 1904 were not quite dry on the surface, and, when exposed to the sun, oil was still found to ooze out. This difficulty was overcome by employing only thoroughly dried wood with a clean surface wholly free from bast. It is impossible as yet to say whether this cheaper treatment will be as effective as the saturation process, but this seems likely from the fact that the top and bottom parts of the posts in any case become thoroughly impregnated, and these parts are the ones chiefly attacked. In the central parts of the pole the amount of oil absorbed and the distance to which it penetrates depend largely on the state of dryness of the wood. Of forty-seven of these creosoted poles erected in 1904 in fungus-infected ground, all were still perfectly sound in 1906, whilst out of thirty-seven poles impregnated with copper sulphate and erected at the same time in the same ground, twenty-three, or sixty-two per cent., have already had to be replaced through the attacks of fungi. The annual extensions and replacements on the Austrian telegraph lines call for some 150,000 poles, and this large demand obviously justifies considerable experiment. Thus experiments are being made with a view to the employment of the larches of the Alps for this work. Experiments are also being made with other more direct antiseptic liquids in place of creosote. Besides copper sulphate such preservative compounds which are soluble in water and, therefore, suitable for use in the Boucherie process, include bichloride of mercury, zinc chloride, and zinc fluoride, both of which are to be tried by the Austrian Government during 1907.

Oakland, Cal.—The Western Union Telegraph Company has been granted permission by the Board of Public Works to place its wires on Broadway from Seventh Street to its main office in underground conduits. This is in line with the work of removing all overhead telegraph, telephone and electric light wires in the business district under an ordinance which was passed several years ago.

NEWS NOTES

TRANSMISSION.

Chihuahua, Mex.—The great hydro-electric enterprise projected on the Conchos River at La Joya is to be carried out now, according to the statement of Engineer Tye, of the Canadian Electric Syndicate, of Montreal, Canada.

Redding, Cal.—Sometime this week a test will be made at the plant of H. H. Noble, on Pit River, in this county, of smelting iron ore by electric heat. Should success attend the test now, the work of installing a plant with a capacity of handling 500 or 1,000 tons of ore per day will be undertaken at once.

Reno, Nev.—Engineers Thurston and Campbell, representing Boston capitalists, arrived here from Southern Nevada last week, after making an inspection of the Colorado River for power purposes. They have been inspecting the mining camps, which they proposed to serve with one of the greatest systems ever built on the Coast.

Nevada City, Cal.—There is a big break in the Milton Ditch on the Bloomfield side of the ridge, near Lake City, and the Northern California Water and Power Company has quite a task before it in repairing the damage. A pipe line will be constructed across the place where the landslide has broken the ditch.

Redding, Cal.—The Northern Light & Power Company has made application for a franchise granting it the right to construct and maintain pole lines along the public highways and through the streets of unincorporated towns of the county. The Board of Supervisors has ordered that the regular advertisement be made. The Northern Light & Power Company, which was incorporated three months ago, proposes to develop 7,000 horsepower on Cow Creek. The Pacific Power Company, another enterprise, is erecting a power house on Battle Creek, but it has not yet asked for a franchise. The Shasta Power Company is nearly ready for business. Ten thousand pounds of wire were received in Redding last week and 90,000 more are coming. The wire will be stretched on the poles, which are in place all over the city.

Eureka, Cal.—Keen competition leading to rate cutting may be the outcome of the announcement of the plan of the North Mountain Power Co., that it will construct a gas plant here to compete with the Eureka Lighting Co. The announcement that the North Mountain Co. would enter the gas business has stirred up no little activity in the camp of the local company. Its representatives argue that there is not enough business in town to support two companies and one must succumb. In the eyes of the Eureka Lighting Co. the other corporation is simply bluffing in the hope that it will succeed in taking over the Eureka company's plant at a small figure. If the declaration of the North Mountain Co. is carried out, the rate war will begin. Superintendent Patch of the local company says: "I do not believe that our city is and will not probably be in the near future, large enough to support two gas companies. The inevitable result will be that the people of Eureka will have to pay a much larger rate for both gas and electricity on account of the large amount of capital invested in two gas plants. One thing can be relied on, however, that this company will hold the field it has occupied so long at any cost."

TELEPHONES.

Spokane, Wash.—The Interstate Tel. Co. is extending its line to East Greenacres.

La Conner, Wash.—The Skagit Valley Tel. Co. has ordered a new 100-line switchboard.

Kendrick, Ida.—The Taney Telephone Company has been incorporated with a capital of $1,000.

Maple Falls, Wash.—The Maple Falls Tel. Co. is stringing wires on its line from this place to Deming.

Vancouver, Wash.—The County Commissioners granted franchises to the Amboy Tel. Co., also the La Center and View Tel. Co.

Seattle, Wash.—City Electrician Howard Joslyn is installing 25 new police patrol report stations in the residence districts of the city.

Boise, Ida.—General Superintendent H. Sommers, of the R. M. Bell Tel. Co., states there will be extensive improvements in the system for this divisions within the next four months.

Bellingham, Wash.—The Sunset Tel. Co. has assisted in the establishment of a telephone company on Whidby Island in the Langley district, which will have 80 miles of line and will connect with this place.

Dillon, Mont.—The Centennial Tel. Co. has been organized with a capital of $20,000 by Robert T. Boatman, A. C. Wakefield and Pearl I. Smith. The company will build a line through the Centennial Valley from Monida to Lakeview.

New Westminster, B. C.—The farmers of Delta municipality have organized a telephone company and will at once commence the construction of a line twenty miles in length. H. M. Basey is at the head of the company.

Vancouver, B. C.—Work has been commenced on the construction of the Coquitlam and Burnaby Telephone Company's lines, which will extend from this place through Burnaby, New Westminster, Coquitlam and the Fraser valley to Chilliwack.

INCORPORATIONS.

Santa Barbara, Cal.—Three new oil companies, the New Pacific, the Mountain, and the Bickmore, have filed articles of incorporation here.

San Francisco, Cal.—The Metropolitan Light and Power Company has filed certificate of increase of stock from $5,000,000 to $10,000,000.

Redlands, Cal.—The Linda Vista Water Company has been incorporated here with a capital stock of $24,000, all of which has been subscribed.

San Rafael, Cal.—Chas. Harrison, a millionaire mining man from Mexico, and F. P. Howard, a local capitalist, are about to form a corporation for establishing a new water system in this part of the county and southern Marin. The Howard estate has several watersheds that could be used to supply many places with water.

POWER AND LIGHT.

Aberdeen, Wash.—W. W. Seymour, of Tacoma, has purchased the plant of the Grays Harbor Gas Co., for $100,000.

Ballard, Wash.—Council granted a franchise to Henry Drum to furnish power and light to a number of manufacturing plants.

Chelan, Wash.—The Chelan Electric Co. has purchased the plant of the Chelan Electric Light and Water Co.

Falls City, Ore.—Council has decided to expend $50,000 in installing a new light system.

Freewater, Ore.—The Walla Walla Valley Traction Co. has decided to build a sub-station at this place.

Olympia, Wash.—Council granted a franchise to W. F. Dole, of Portland, for the erection of a gas plant here.

Olympia, Wash.—The Olympia Gas & Light Co. has purchased a site at corner of First and Columbia Streets, for the erection of a new gas plant.

Oregon City, Ore.—Douglas Taylor has filed notice of appropriation of 4,000 inches of water from Still Creek and Zigzag Creek to develop electric power.

Portland, Ore.—The Portland Ry., Light & Power Co. will build an electric transmission line from Oregon City to Salem.

Seattle, Wash.—The Seattle-Tacoma Power Co. will enlarge the capacity of their plant at Snoqualmie Falls this season. The output will be increased from 4,000 to 10,000 horsepower.

FINANCIAL.

San Francisco, Cal.—Rumors that the United Railroads of this city are for sale are emphatically denied by President Calhoun, of the company. He admits that he has received offers from Eastern capitalists, who have a false impression that the stock may be bought for a bargain From New York comes another denial that there is in progress negotiation for the sale of the company to Thomas F Ryan, the street railway magnate there.

San Francisco, Cal.—Spring Valley's financial straits, its lawsuits that have covered years and are still unsettled, and all its controversies with the city and the rate payers, are to be settled with one fell swoop, if the permanent committee of allied commercial associations can carry out its plan. Representatives of twenty-three commercial associations and improvement clubs met recently and discussed the problem of the city's water supply, both in its immediate aspect and future necessity, and approved a plan, which, if successful, will please the Spring Valley officials, the city government and the rate payers. The proposition is for an appraisement of the system of water supply owned and operated by the Spring Valley Co., this appraisement to be used in arriving at a water rate which will earn 5 per cent to the company, and also to be used as a basis for an option for the sale of the company's plant to the city at some time within the next ten years. All litigation is to be ended. After having agreed to the proposition the water company would be able to sell bonds and provide an adequate supply for the immediate needs of the city, and when the supply from the Sierras is inaugurated the city is to purchase the Spring Valley system and use its network of delivery pipes for the distribution of the water that is to be brought from the mountains.

Oakland, Cal.—The committee of the whole recommended last week at the meeting of the City Council that a water rate be adopted for the coming year, which is a ten per cent reduction on the rate paid last year. Besides this, the rate for the municipality will be 20 per cent lower, and the cost of supplying hydrants will be reduced from $5 to $3 if the recommendation of the committee be approved by the Council and accepted by the Peoples' Water Co. That it will be approved is made practically certain by the statements of Louis Titus, president of the company. He was questioned at length by members of the Council, and admitted that the reduction was a fair one. It is understood that the rates as recommended by the committee will be the ruling rates for the coming year. Titus said that to provide more water, more than $2,600,000 had already been spent during the past year in actual construction, purchase of land about Lake Chabot, and about San Pablo Creek. The new San Pablo system, which will be used exclusively for Oakland when it is completed, will cost $4,000,000 in all, and will be able to furnish 8,000,000 gallons of water daily. In fixing the rates the Council will, however, increase the valuation of the plant by the amount that Titus said had been spent in improvements during the past year, which amounts to more than $2,600,000, making a total valuation of $9,600,000 in round numbers. The rate actually paid in the past has been on $7,000,000 valuation fixed by the decision of Judge Hart.

TRANSPORTATION.

Fresno, Cal.—The surveying of the Fresno-Yosemite electric line is about completed. Another month's work will see it finished. Maps have been made as the survey progresses, and by the time it is completed all the data will be available for use in financing the project. The Pollasky Road, belonging to the Southern Pacific, will be used from Fresno to Pollasky and from there to the valley the new line will be built.

San Bernardino, Cal.—An electric railway from Redlands to Riverside, with another branch to Craftonville, is being promoted by Redlands capitalists, who have organized the Redlands Central Railway Company. Articles of incorporation were filed April 19 with the capital stock stated at $100,000. It is believed here that the new road will ultimately be extended to all parts of the valley and become a rival to the Huntington system, which includes the San Bernardino Valley Traction Company and the Riverside-Arlington Electric Company.

Stockton, Cal.—By June 1st people from here may go by rail to Lodi via the Central California Traction Company. Lew Moreing has a contract to build the road before that time. Active operations have been already commenced. This is the first step toward the construction of an electric system, which is expected to be important. It is claimed that the Central California Traction Company is co-operating with the Northern Electric Company, which is connecting Redding with Sacramento, and that in the near future it will be possible to make the trip from here to Redding by electric rail. From Lodi the Traction Company is expected to continue its construction work until it connects with the Northern Electric Company, near Sacramento.

Stockton, Cal.—The Central California Traction Company, which is building an interurban line between here and Sacramento, must bid at public auction for the franchise it desires to carry freight over the streets for which it has already obtained a passenger franchise. This is the result of the decision rendered by Superior Judges Frank Smith, W. B. Nutter and C. W. Norton in the friendly suit brought by the traction company to determine the legal interpretation of the city charter. The question arises, if the freight franchise is sold to the highest bidder, and that person or corporation happens to be other than the Central California Traction Company, will the purchaser be entitled to haul freight over the tracks of the company now in possession?

ELECTRIC RAILWAYS.

Bellingham, Wash.—Stone & Webster are making preparations to rush work on the Bellingham-Skagit County interburban railway.

Seattle, Wash.—Council granted a franchise to the Seattle, Renton & Southern for the operation of railway lines on streets of the city.

Tekoa, Wash.—F. J. Mahoney of the Tekoa & St. Maries Railway Co. states that work will be started at once on the project. The road will be fifty miles in length.

Port Angeles, Wash.—Arnold Zinden, H. B. Kennedy and Fred A. Ballaine, of Seattle, have applied to Council for a franchise for a system of street railways.

Libby, Mont.—J. H. Geiger has returned from the East, where he has secured the money for the erection of the projected line from this place to the Fisher country.

Boise, Idaho.—The Boise Interurban Railway Company has commenced the erection of a car barn 50x150 feet with a 25x40 machine shop at Park, four miles down the valley.

North Yakima, Wash.—Construction work has been commenced by the Inter-valley Traction Company, under Engineer Kenley. A system 250 miles in extent is contemplated.

Missoula, Mont.—Fred C. Soddard has been appointed special right-of-way agent for the Missoula-Bitter Root Traction Company. The new road, which will extend from this place to Hamilton, is now assured.

Seattle, Wash.—The County Commissioners granted a franchise to the Seattle Electric Co. for an extension of the Rainier Heights line to Rainier Beach; also for the extension of the South Seattle line over Michigan avenue to Oxbow.

Bakersfield, Cal.—The independent producers of the Coalinga and Kern River oil fields are hard at work on the plans for their pipe line to be built from the local fields to Coalinga, and from there across the mountains to tide water near San Jose. As a start for the immense sum needed the independent producers' agency of the local field has set aside $140,000, which was received on April 20th from the Associated oil companies as the second payment on the contract of the independents with that concern. This money will be used as a nucleus for the portion which the producers of the Kern River fields will furnish for the pipe line. The cost of the line will be about $7,500 a mile for 225 miles, and this expenditure will be shared by the local and Coalinga producers. A meeting was held in Coalinga on May 3d to discuss ways and means for the enterprise. Timothy C. Spellacy, W. B. Robb, L. P. St. Clair and F. M. Scofield attended as representatives of the local producers' agency.

The JOURNAL OF ELECTRICITY POWER AND GAS

WITH WHICH IS INCORPORATED The Engineers', Architects' and Builders' News

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THE

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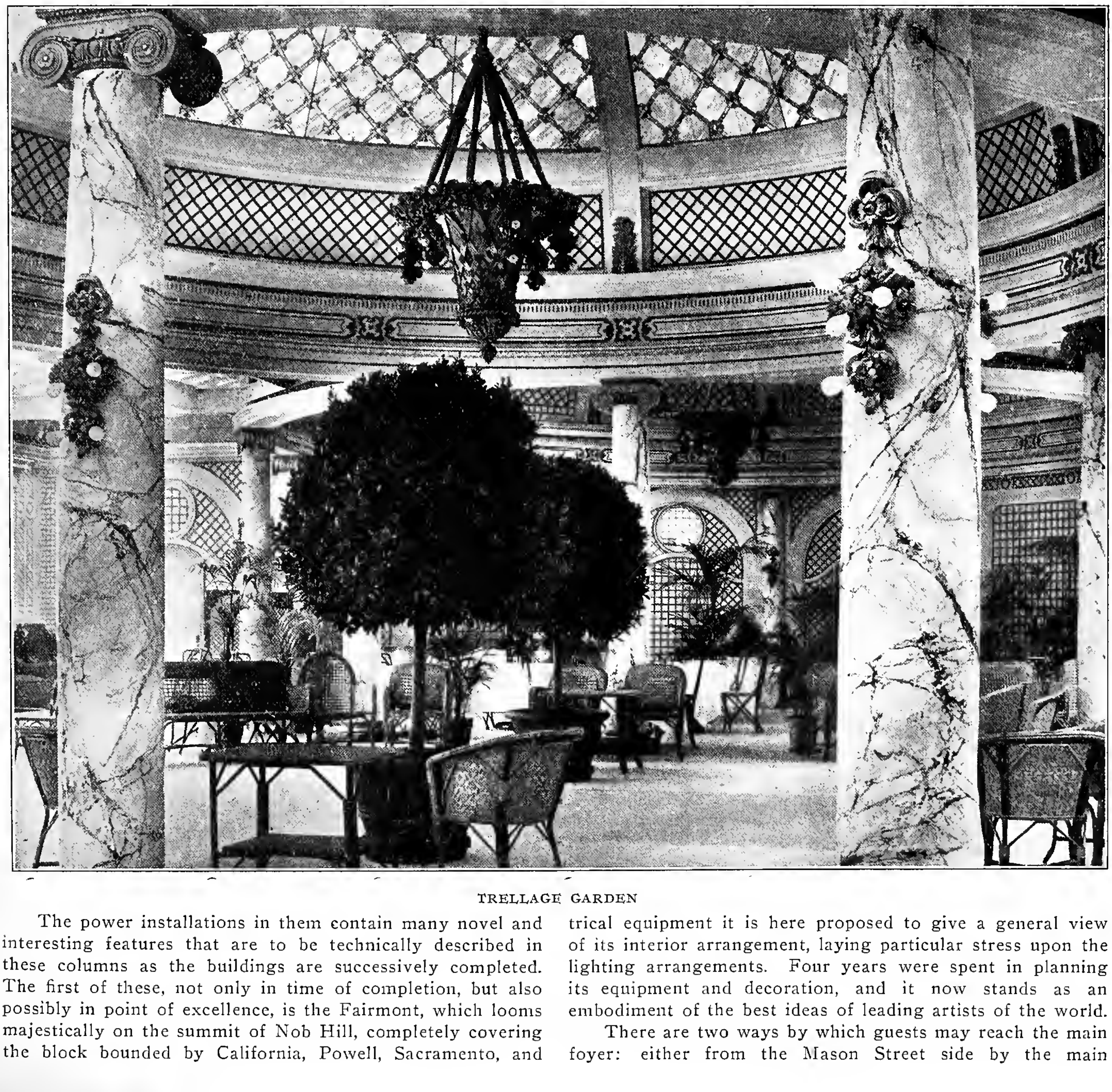
VOLUME XVIII. SAN FRANCISCO, CAL., MAY 11, 1907 No. 19

HOTEL FAIRMONT

Much has been written of the self-contained completeness of the modern ocean liner, likening it to an up-to-date town in its detail for the material comfort of man. But as the town seems small when compared to the large city so does the liner when contrasted with the spaciousness and magnificence of the large hotel. Just to be launched to the trade of the traveling and comfort-loving public are three hostelries on the shore of San Francisco Bay. These are the Fairmont and St. Francis in San Francisco and the Claremont at Berkeley.

The power installations in them contain many novel and interesting features that are to be technically described in these columns as the buildings are successively completed. The first of these, not only in time of completion, but also possibly in point of excellence, is the Fairmont, which looms majestically on the summit of Nob Hill, completely covering the block bounded by California, Powell, Sacramento, and Mason Streets. On May 1st of this year the management of the Palace Hotel took over the running of this magnificent institution, having taken an advantageous lease from the Law brothers, to whose indefatigable efforts is due the credit of its speedy rehabilitation after the earthquake and fire of 1906. In replacing what was burned, they profited by the teachings of the fire and utilized every means of making it fireproof. The outside covering of white terracotta and granite conceals the massiveness of the steel and reinforced concrete within.

As a preliminary to an extended description of its electrical equipment it is here proposed to give a general view of its interior arrangement, laying particular stress upon the lighting arrangements. Four years were spent in planning its equipment and decoration, and it now stands as an embodiment of the best ideas of leading artists of the world.



TRELLAGE GARDEN

There are two ways by which guests may reach the main foyer: either from the Mason Street side by the main

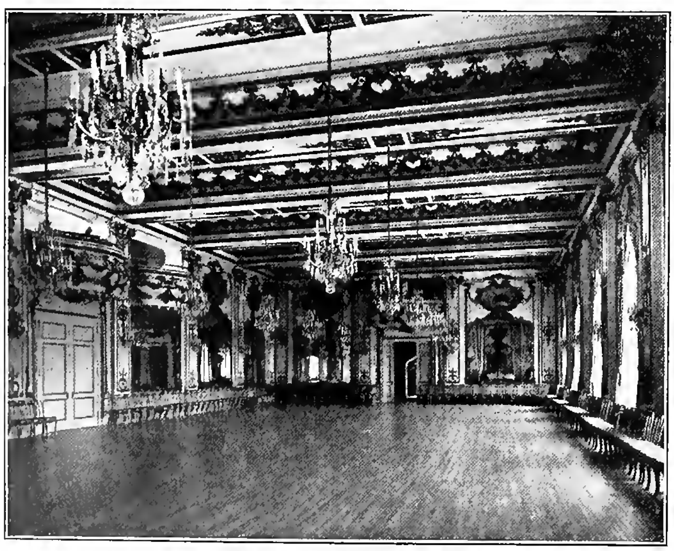
entrance, with which it is on a level, or by tunnel and elevator from Powell and California. The ten floors of the building are served with both passenger and freight elevators for all conceivable purposes.

On entering the vestibule one has a view of the "Trellage Garden," opening from the foyer directly opposite. As will be seen from the first illustration, it is arranged to give the effect of an open-air garden. It consists primarily of three domes, supported on variegated marble columns. The arbor-like effect is supplemented by potted palms and rare exotics. During the day the light comes with a subdued radiance from above through large domes of art glass. At night the main light comes from the pendant globes in the zenith of each dome and from the beautiful side fixtures, whose details are best seen in the picture. This is used as a grill and will accommodate nearly four hundred.

The main foyer contains the office and is the center from which all parts of the hotel may be reached. Here again the main lighting is from above, with auxiliary smaller lights placed on the marble columns for convenience. The hangings of dark red complete the representation of a room of the period of Louis IV. Opening from this on the Mason Street side is the ladies' drawing room and the writing room, the latter equipped with individual desk lights.

The ballroom opens from the north side of the foyer and extends parallel to Sacramento Street, which is overlooked by large windows with beautiful blue hangings. The remaining three sides are finished in large French plate mirrors, interspersed with decorative panels and mural paintings. Brilliant illumination is obtained from the eighteen massive chandeliers, hung from the ceiling by gold link chains.

The dining-room gives a fine view of the bay and Berkeley hills on the Powell Street side. This is finished in white and gold in the style of Louis XV. From each ceiling beam is pendant an immense chandelier, giving a general illumination which is individually intensified by electric lights at each table. The fixtures here, as well as throughout the whole building, are in accord with the rest of the decorations. The adjoining breakfast room, finished in gray and white and separated from the dining hall by mirrored doors, has an immense cluster of lights hanging from the center of the ceiling, which is twenty-four feet above the

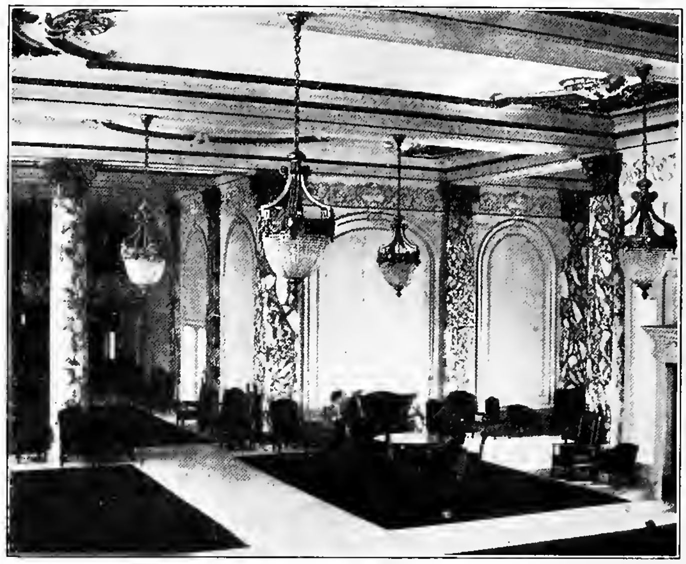


BALL ROOM

floor.

The halls in the upper floors are well lighted by enclosed globe lamps, each hall having separate switch connections. The room electric light fixtures are in accord with the color scheme.

The upper stories are devoted to the guest rooms, lounging rooms, reading rooms and dining halls, while in the lower floors are placed the kitchens, pantries, servants' quarters, store-rooms, laundry, power-plant, refrigerating plant and ventilating fans. The kitchen is tiled floor to ceiling and is furnished with glass and marble counters and



MAIN FOYER

shelves. Live steam will be used for most of the cooking. As originally planned electric cooking was to be an important adjunct of this department. But the additional equipment brought over by the Palace Hotel management has made this out of the question for the present. The laundry and ventilating plant are run by electricity and will be described in detail, together with the power plant, in a succeeding issue.

SECOND-HAND EDISON LAMP RULING.

A permanent injunction has been issued by the United States Circuit Court, District of New Jersey, restraining William F. McKeon and Joseph Conning of Newark, N. J., from selling second-hand incandescent lamps unless marked "Used and Second-hand." The decision signed by Judge Cross ends a litigation between the General Electric Company and the defendants which had extended over a period of three years. Similar suits were instituted, one against Edward Mills, proprietor of the Newark Electrical Supply Company, and the other against Frederick W. Chase, proprietor of the Lamp Supply Company of New York. Neither of these parties defended, and decrees were therefore taken against them by default.

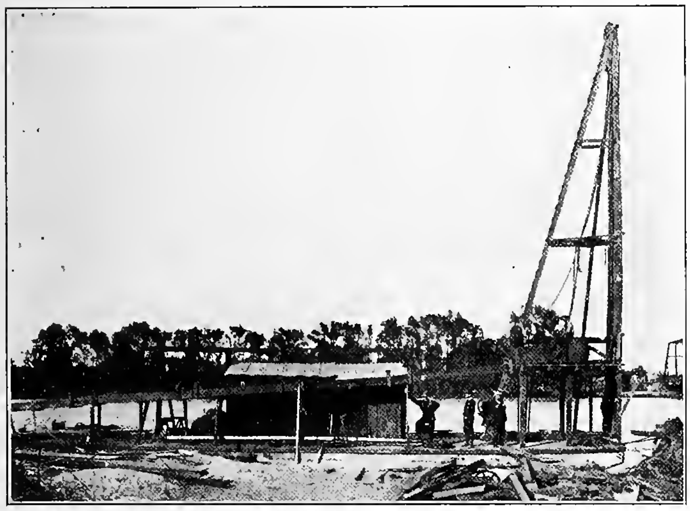
REMOVAL NOTICE.

The Gould Storage Battery Co. will move from their present offices, No. 1 West Thirty-fourth Street, to Nos. 341-347 Fifth Avenue, corner of Thirty-fourth Street, New York City, on June 1.

The Pacific Fire Extinguisher Company has moved its main office to 507 Montgomery Street, San Francisco.

PNEUMATIC PIPE DREDGE.*

A new dredge is being operated on the American river near Sacramento that promises to solve the overflow and reclamation problems of the Sacramento and San Joaquin rivers. It is known as the bed-rock pneumatic pipe dredge. Instead of sucking up sand from the surface of the bed of the river as in the ordinary suction dredge, or bringing up the sand in buckets or shovels, its pipe "jets" its way through the sand at the bottom of the river to bed-rock and lifts the material from there or from any point between the river bottom and bed-rock.



The sand is lifted through the discharge pipe by use of compressed air and water, which are forced from above down several small pipes surrounding the large central discharge pipe into a mixing chamber. The resulting mixture of compressed air and water is then discharged from below into the larger pipe and creates a vacuum at the bottom of the pipe, with the result that the surrounding sand is drawn into the vacuum and forced up through the pipe. In the test made last week the material raised consisted of over 40 per cent of sand.

So successful was the demonstration and so great the quantity of sand raised in proportion to the amount of water that old river men, who have been paying out money all their lives for the building and repairing of levees around their farms, were astounded, and they heralded the new dredge as the salvation of the farming interests in the valleys of the Sacramento and San Joaquin rivers. For the dredge had demonstrated not only that it could lift sand from the very bed-rock of the river at any depth—lift it to any required height above water level and the levees, and discharge it wherever required at a cost considerably lower than any other type of dredge now in use—but it also demonstrated that it could select the materials with which to build levees by bringing up coarse sand and gravel from one stratum of the river bed for the foundation of the levees and the lighter silt for the top covering of the levees from another stratum. The pipe was entirely under control and was raised and lowered at will through the various strata. Furthermore, the cost of constructing the dredge is so small compared with other dredges, and its capacity is so great, that in comparison with the $30,000,000 damage caused by the river floods this year only a small sum would be required to place a chain of these pneumatic dredges at work up and down the river. This would not only build substantial levees and reclaim lands all along the river, but also clean out the river channels and restore navigation to the standard of 1849, at which time boats went up. The pipe can go directly to the bed-rock of the old river channels, prospect for the gold values and bring the sand containing the gold to the surface without first removing the many yards of valueless material and bowlders that overlie the auriferous gravel and black sand. In this way the gold values can be recovered from the river bed while the sand removed can be used in levee building and reclamation work.

*Condensed from Sacramento Union, April 28, 1907.

RATEAU TURBINE COMPRESSOR.

By E. N. Percy.

A new turbine compressor, designed by Rateau, is attracting a good deal of attention. It has a maximum capacity of about 400 horsepower, at 4,500 revolutions per minute, on much the principle of a Parsons turbine, and was designed for purposes of investigation, under the auspices of the "Societe des Turbomoteurs a Combustion," Paris. The trial, as given in the "Schweizerischen Bauzeitung" of November 17, 1906, ran as follows, the compressor being intended for use in connection with a gas turbine:

Trial of the Rateau Turbo Compressor.

No. of Rev. per min.	Pressure in suction pipe. kilogram	Pressure in discharge pipe. Atmosphere	Barometer millemeters	Air Temperature Centigrade		Heat given to circulating water.	Air Quantities u P S e		H. P.
				Suction	Discharge		cbm sk.	cbm st.	
4030	50.5	4.07	727.5	29.5	67.9	120,722	0.597	5.3	406
4000	103.8	3.75	732.6	27.1	72.5	131,383	0.856	8.	375
4000	137.7	3.50	731.	28.6	78.5	160,626	0.985	9.85	350
4000	164.	3.315	732.6	27.	79.	147,620	1.076	11.84	350
4000	270.	2.52	732.6	25.9	80.		1.381		
4000	261.3	2.417	727.5	30.	87.3	150,000	1.358		
3055	85.	1.32	728.5	23.	50.5	62,000	0.770		
3520	117.	2.06	728.5	25.	65.2	90,000	0.910		
4470	202.	4.78	728.5	26.8	96.	206,212	1.195		
4250							1.13	10.17	400

From the above data, the efficiency and other matter can be worked out. It is likely that smaller sizes of turbine compressors, for smaller pressure, can be built, which will play a very important part in the development of a new type of auxiliary machinery.

XI. MODERN CENTRAL TELEPHONE STATIONS.

Lecture Delivered by C. E. Fleager, of the Pacific Telephone & Telegraph Company, on March 13, 1907, to the Students in the Department of Electrical Engineering, in the University of Washington.

In discussing tonight the subject of "Modern Central Telephone Stations," I wish to point out the principal features of the complex equipment going to make up plants installed under modern engineering ideas in the larger cities. In the early days of telephone work the Central office was, perhaps, owing to the undeveloped possibilities and the entire lack of special knowledge on the part of many exchange managers and engineers, so little studied from an engineering standpoint that no type of central office plant had been decided upon as the best adapted type for use. In the last ten years, however, the Multiple Central Energy lamp signal manually operated switchboard has proven itself to be the best adapted to give efficient and good service. It will be this type I discuss.

There are several things in addition to such a switchboard that are necessary for the complete, efficient, and economical working of such a plant. In outline they may be given as follows:

1. The Building.
2. The Protective Apparatus.
3. The Main Distributing Frame.
4. The Intermediate Distributing Frame.
5. The Power Plant.
6. The Switchboard.
7. Special Desks.

My first sub-division (The Building) is one that until recently was probably as much neglected as any, if not more. It was thought that most any building, such as is usually known as commercial quarters, would be sufficient.

However, let us look at a few points not usually found in an ordinary building, which I think will prove that the building must be designed to meet the requirements of the apparatus.

In the first place, the building must be designed for especial protection against fire, as the modern telephone equipment is a vital part of the city's business life, and every precaution should be taken to guard against interruptions to the service. All modern buildings tend towards strictly fireproof structures; so let the telephone building be as modern as possible.

Again, in case of a general fire, such as visited the city of San Francisco, the underground cables need special protection, as these cables are the hardest to connect, being arranged with one hundred pairs of wires having the same color of insulation; while the switchboard cables are arranged with insulation in color codes. This, then, establishes the requirement that the end of the underground cables (termed potheads) should be placed in a fireproof room or vault.

The location of this vault should be between the entrance of the underground cables from the conduit system and underneath the main distributing frame. This location is usually in the basement, as the underground cables can then be brought directly to the pothead rack on the main conduit level, requiring only a simple construction.

The building should be of strong construction, as the weight of the iron and copper going to make up the complete plant is considerable, and, of course, one need only glance at this point to determine that a building designed for the particular requirements will be the most economical.

Again, the amount of copper wire and cable required around the plant can be kept a minimum only by a proper arrangement of the apparatus, which can only be obtained by a pre-determined building arrangement.

In summary then, the building should be designed after the details of the central station equipment have been decided, and with a view of giving the best possible arrangement of such apparatus, keeping in mind proper allowance for growth. Special fire fighting apparatus should be provided, carefully placed and maintained.

The modern protective apparatus usually consists of the carbon airgap, lightning arrester, and the heat coil. The details of assembly differ widely with the different manufacturers, but they may be divided into two general classes:

a. Those in which the heat coils must be replaced with other coils after operation.

b. Those in which the heat coils are self-soldering, requiring only that the position of the coils be changed.

In either division the carbon arrester is used, as this is found to be practically the only efficient arrester. It consists of two blocks of carbon separated by a thin piece of notched mica; one of the blocks having a piece of fusible alloy placed near the center and exposed to the open space between the blocks, the other being solid carbon. The heat coil proper, consists of a small coil of wire wound around a metal bobin, which bobin is soldered to a pin inside of it. The pin extends through the bobin sufficiently to engage a spring clip of the protective mounting. The theory of operation is that when a current of greater amperage than the rated capacity of the coil flows in the circuit, the wire is heated, causing the bobin to become unsoldered from the pin, thereby allowing the circuit to open and the outside circuit to be grounded.

In the case of the self-soldering coils, the pin resolders itself after such action, and it is only necessary to reverse or reset the coil in position, provided the insulation of the wire or the wire itself has not been damaged. The carbon arrester operates on the air-gap principle, and needs no further comment.

The location of this protective apparatus is usually confined to one of three places. It may be at the cable head in a separate room, or on the main distributing frame, either directly on the end of the underground cable wires or on the end of the inside circuit wires. The placing in a separate room at the cable head gives an ideal condition from a fire hazard standpoint, but as this risk is very small and the arrangement bad for the maintenance department, the main distributing frame is usually used. The placing on this frame directly on the underground wires gives a better protection than if placed on the inside circuit side, for the reason that, should the heat coil be blown and the foreign current remain on the underground wire, there is a minimum amount of apparatus charged for exposure to crosses with other circuits.

I have spoken of the main distributing frame, but have given no definition or description of it. It may be defined to be any apparatus that will allow of ready cross connection at will of the underground wires to the wires leading to the switchboard in such a manner that the cross connecting wires can be easily traced or removed. Early frames were of several different forms but experience has brought us to the adoption of an iron frame rack having the protective apparatus arranged vertically on one side and terminals horizontally on the opposite side. A favorite construction is angle irons arranged vertically for the main support and cross bar iron horizontally, connected near their center to the angle irons at the heights of the various horizontal shelves. The protective apparatus is fastened directly to these cross irons at one end and terminals at the other. Longitudinal irons, to properly bind the various uprights together, are arranged at the same height as the horizontal terminals or shelves and carry rings properly insulated and fastened. The cross connecting wires are passed through

these rings, being passed through the particular ring in the same vertical plane as the protector-lug and in the same horizontal plane as the terminal lug which are to be connected together.

The cross connection wire should be insulated with rubber and a flame-proof covering, the gauge of the wire to be at least No. 22 B. & S. The insulation should not be bulky and should be of different colors on the two wires. They should be twisted together with at least one twist in every three inches.

The cables connecting the underground cable side of the main distributing frame with the underground cable potheads should be lead covered, the gauge of the wires to correspond with the gauge of the underground wires. The insulation should be of cotton and silk. In making splice to the underground cable, the joint should be sealed, using the method used by plumbers. The cables should be arranged in some predetermined method to allow of their neat and convenient entrance into the rack and to distribution to the various terminals, allowance for proper growth having been considered.

If the main distributing frame is so large that the average man can not readily reach all terminals when standing on the floor, sliding ladders should be provided. Electric lights should be arranged with special care and should be of such a design as to prevent any possibility of the electric current becoming accidentally crossed with the telephone circuits. Some apparatus for testing defective heat coils and for holding idle coils, carbons, and tools should be furnished. Also a waste can for the disposal of short lengths of cross-connecting wires or defective wire. There should also be a reel for new wire, and stone or soldering iron receptacle. The wire chief will require portable connecting sets for test trunks to this frame.

Taking up the inside circuit at the main distributing frame and following it towards the switchboards, we next come to the intermediate distributing frame. This frame is similar in construction and appearance to the main distributing frame but serves a different purpose. This is the cross-connecting of the various circuits to the multiple jacks (which correspond to the telephone numbers), thereby allowing of the proper bringing together of the various numbers on a party line and the distributing of the traffic load evenly to the different operators. It is this intermediate distributing frame that allows of the changing of the operator's position on which your line is answered without your telephone number being changed.

The same general conditions hold for this frame that hold for the main frame. Where the exchange is not too large the frames are usually placed in the same room. Wire chief's desk and power plant are also usually placed in this room which is named the apparatus room. This allows of the more economical handling of the maintenance of the plant.

Closely associated with the intermediate frame is the relay rack which holds all the line relays. Cabling is extended from these relays to the vertical side of the intermediate frame and from there to the answering jacks located in front of the answering apparatus operators at the switchboard. The horizontal side of the intermediate frame carries the terminals connecting with the multiple jacks.

The power plant of a telephone office equipment, while not of gigantic proportions or of varied styles of machinery, yet it bears some distinctive features not found in any other electric plant. In general, the power plant consists of:

Storage battery.
Electric-driven charging units.
Engine-driven charging units.
Power panels.
Fuse.
Ringing and special apparatus.
Wiring.

The storage batteries are of the usual commercial type, the only distinctive feature being the ample size, considering their load and the unusually large space allowed for sediment. The large size is necessary as it is not common practice to provide a reserve set of batteries, the battery being floated across the bus-bars in parallel with the machine, and it is desired to provide good reserve in case of injury to machines or failure of power. The large space for sediment is provided, owing to the fact that the batteries are not severely used and it is not desired to remove or disturb plates for the cleaning of sediment. The batteries are mounted in the usual manner—lead-lined trays or glass jars being used and double insulation is given in order to prevent any chance of leakage interfering with the telephone line, the receiver being very sensitive to small currents. A separate room should always be provided and be equipped with necessary ventilation and appliances for treating batteries.

The electric-driven charging units vary of course with the available power obtainable in the city, the motor bearing no decisive feature. The generator, however, is of low voltage and comparatively high amperage. Owing to its being footed across the discharge leads, the commutation must be perfect. A low resistance, high impedance coil is often inserted in series with the generator to further prevent any possible disturbance from fluctuation of voltage due to poor commutation.

If the design of the plant requires two voltages, the second voltage being often employed in long-distance talking, a second set of batteries is employed. To economically charge this No. 2 battery which is of smaller size, a second electric-driven machine is employed. It is not considered necessary to have a reserve-charging machine for No. 2 battery as the larger machine can be used should the smaller one be out of order.

Gas engines are the favorite emergency power. Usually this is connected to a generator, the duplicate of the one mentioned above. The gas engine has no special feature but should be reliable and give steady power.

The power panels are usually similar to those in use at central lighting plants, often being of slate. The necessary switches and meters are mounted upon them in the usual manner, possibly the most important switch being the one for measuring the voltage of the various individual storage cells.

The ringing apparatus consists of two sets. One is either belt or direct connected electric motors and generators, the motor being designed for use on the city supply of electric current, the generator to deliver current at a voltage of from 75 to 110. The other set is for emergency use and is designed to have the motor driven by electric current taken from the storage battery. This set is usually a dynamotor. Both generators are usually duplicates of each other. Their size is determined by the size of the exchange.

On these ringing machines are mounted such special apparatus as may be needed for the generation of special signalling currents and tones. A favorite type is to mount the apparatus requiring a large number of interruptions on the same shaft as the ringer armature and gearing a slower speed apparatus to this one. The special signalling currents are used for such information as "The line is busy," "The party doesn't answer," etc.

In connection with the power plant might be mentioned the fuse board. This is a slate panel with rows of fuses mounted in symmetrical order, a special battery bus being supplied for one end of the fuses and battery posts for the other end. The fuses used are of the alarm type, alarm circuits being arranged so that proper signal is given when any fuse is blown. Apparatus allowing of the quick finding of the blown fuse should be supplied and usually consists of lights so arranged that the row in which the blown fuse is located is indicated at once and either a flexible cord and finder permits of locating the individual fuse or the fuse has a small indicator attachment which comes into view

when the fuse is blown. All fuses in the battery circuits as far as possible should be located on this panel.

The wiring found about a telephone power plant follows general practices, the principal point to be noticed being the ample size of the conductors. This is necessary, as the return and battery potentials must be the same relative values at all parts of the switchboard, as very small differences produce noticeable effect in the sensitive telephone receiver.

Our next general subdivision of the central office plant (the switchboard) is probably the most interesting and instructive of all. It certainly is the larger and more complex part. The size and exact details of the switchboard of course will depend upon the size of the exchange. It can be divided into two portions, as:

a. That portion devoted to answering calling subscribers and the completion of their calls either directly to the multiple jacks located in that board or with the assistance of another operator to some other exchange.

b. That portion devoted to assisting some operator at a distant exchange in connecting the calling subscriber in that exchange to the called subscriber in this exchange.

The first portion is called the subscribers' or "A" board, and the second portion the trunk or "B" board. In case there is but one exchange in the city it will not be necessary to have "B" boards until there are more subscribers in the city than can be called from the "A" board by the "A" operator. The surplus in such a case may be placed on a "B" board situated in the same building which would be called a "local 'B' board."

Taking up first the "A" board, we find four decisive divisions of the apparatus:

1st. Apparatus of the operators' positions.

2d. Apparatus of answering jacks.

3d. Apparatus of multiple jacks.

4th. Apparatus of trunk jacks and special.

The operators' positions are usually three to each section of switchboard. The apparatus on a position consists of the cords and plugs, supervisory or clearing lamps, listening keys, ringing keys, call circuit keys, operators' telephone circuit jacks, and other parts. All of this apparatus is mounted in the horizontal portion of the switchboard. The cords are conductors, properly insulated and protected against wear, which forms the flexible connection necessary between the stationary portion of the position apparatus and the plug which is to be inserted into the jacks, thereby making connection with the subscribers' line. The clearing lamps are small incandescent lamps properly mounted in sockets which denote when lighted that the party is either demanding attention or has completed his connection, and same should be disconnected. As there are two of these to each pair of cords the operator is notified of the action of both parties of the connection. The ringing and listening keys are small switches designed to allow the operator to ring the subscriber's bell or connect herself with any particular pair of cords for talking. Each operator's position usually has about twelve to seventeen pairs of cords. The call circuit keys are small switches which allow of the "A" operator connecting herself at will with a "B" operator at some distant switchboard that she may order some subscriber's number which does not appear in front of her connected to a trunk line between herself and the "B" operator.

The operator's telephone jacks are jacks mounted in some convenient place which allows of the operator disconnecting or connecting her head receiver and breast transmitter easily when she leaves or enters the position. Operators are supplied with individual head receivers and breast transmitters.

The answering jack equipment consists of the answering jacks, line lamps, line and cut-off relays, and the necessary terminals and cabling to connect them to the intermediate and main distributing frames for cross connection. The answering jacks and line lamps are usually grouped in rows of ten and placed in the face of the switchboard just above the plug shelf. The jacks and lamps are placed one above the other so that the jack associated with each lamp is easily and naturally determined. The jacks are made in several different styles, almost all of which use hard rubber as the principal insulator. The face of the jack is usually of rubber on which is stamped the jack-numbering and which is attached to a metal framework. Sometimes the frame of the jack is entirely of rubber. Each jack has a cylindrical opening, called the mouth or sleeve, which is of metal. The framework of the plug is made of the same diameter as this opening and makes contact with it as one of the conductors. The other conductors in the plug make contact with springs of the jack when the plug is fully inserted. These springs are mounted from the back portion of the framework of the jack and insulated from each other.

The line lamp is mounted in a suitable socket and in operation is controlled by the line relay. The line relay consists of a small electro-magnet through whose windings an electric current flows when the subscriber's telephone receiver is removed from the hook. This causes a local contact to be made by the attraction of its armature, in turn causing an electric current to pass through the line lamp, making it glow. When the operator answers this call by inserting her answering plug the cut-off relay comes into action, removing or shunting the line relay from the circuit, thereby stopping the line lamp illumination. This cut-off relay is also brought into action whenever a calling cord is inserted in any multiple jack, thus preventing the line lamp from signalling the answering operator when a called subscriber answers his bell. The answering jacks vary in number from sixty to about one hundred and fifty per position, depending on the average load per circuit. Each answering jack appears in one place only.

The multiple jacks are similar in construction to answering jacks, but are mounted twenty per strip. They are arranged in banks of one hundred, numbered from 0 to 99, and are multiplied once in each section; that is, Jack 1 in Section 1, for example, is connected with wires to the terminal on the intermediate distributing frame, from Jack 1, Section 1, to Jack 1, Section 2; Jack 1, Section 2, being located in relatively the same position as Jack 1, Section 1. In similar manner Jack 1, Section 2, is connected to Jack 1, Section 3, and so on throughout the entire switchboard.

With each bank of one hundred jacks is associated on a style casing to the left of the bank a number which represents the hundred and thousand digits of the telephone number. For example, if we wish to find telephone number 7142, we would look on the style casings until we found 71 and then select jack 42 in that bank.

It is possible to place nearly 10,000 multiple jacks in each section so that they can all be reached by the operator. The capacity of the multiple limits the number of subscribers connected to the switchboard, as each multiple jack represents either a telephone number or line, depending upon whether party lines are used or not, and upon the system of numbering in use. In one system each telephone number is given a multiple jack, so that in case of a two-party line two multiples will be connected to the same line at the intermediate distributing frame, and in the case of a four-party line, four multiples will be connected. In the other system where only one multiple jack is connected to each line, the different telephones on a party line each bear the number of the multiple jack and in addition a letter prefix or suffix or similar method of designating to the operators how to ring. In these latter cases the operator's position equipment will be supplied with sets of ringing keys properly marked instead of one key.

The wiring from section to section of these multiple jacks is done by means of cables usually carrying wires for twenty jacks. They are arranged systematically in order to allow of easy finding of any wire giving trouble and to present a neat appearance. The multiple jacks are mounted in the

face of the switchboard so as to leave a small amount of space between the answering jacks and the multiple jacks. In this space is located what are known as trunk jacks, or, in other words, jacks connected to trunk lines leading to other portions of the switchboard, to switchboards in other exchanges, to special desks, etc. These are exactly similar to multiple jacks but have marking or designation strips associated with each row or panel of jacks so that special markings may be used.

The "B" board is in general appearance the same as an "A" board except that the cords found in the horizontal portion are mounted singly instead of in pairs and the answering jack equipment is missing. In this board the trunk lines which we find connected to the trunk jacks in the "A" board are connected to the cords, a designation strip being supplied to allow of the same marking appearing over the trunk jack to be made alongside the trunk cord connected to it.

The operation is this: When the "A" operator desires connection with some subscriber not located in her multiple, she presses the proper call circuit key, thereby connecting her telephone set with the proper "B" operator's telephone set and passes the called telephone number. The "B" operator then picks up some trunk cord that is idle, and after testing in her "B" multiple the desired number, plugs in and rings, advising the "A" operator of the number or marking of the trunk cord. The "A" operator then completes her connection to the proper trunk jack.

The usual lamp signals are supplied on the "B" board but are used in a different manner. One lamp is for the "A" operator to notify the "B" operator when the called subscriber has answered. The completing cord light on the "A" cord works in unison with the subscriber's telephone receiver hook, but the light on the "B" board once in a position denoting that the subscriber has answered does not change, being automatically locked in that position until the "A" operator has disconnected, thus giving the "B" operator the disconnect light. This disconnect signal on the "B" board is controlled by the "A" operator inserting or removing cord from the trunk jack.

The special operating desks consist of wire chief, information, complaint, chief operator, trunk distributing and service observing desks.

At the wire chief's desk all trouble connected with the outside as well as the inside plant is tested and men dispatched to clear the trouble. The desk varies in form, but the essential apparatus is the incoming trunks from the switchboard, test trunks to the switchboard, and distributing frames, and the testing and switching cords.

The incoming and test trunks do not need much discussion, being merely jacks with proper signals and connections. The switching cords are merely two cords connected together very often without signals. The test cords are equipped with listening keys so that the wire chief may connect his telephone set to either cord and may also connect the testing apparatus. There are usually two to five test cords and only one set of testing apparatus per position. The testing apparatus of some standard voltmeter with the proper keys, batteries, and connections, so that resistance measurements may be made to locate the nature and position of the trouble.

The chief operator desk has apparatus for receiving and sending calls to and from the switchboard and for making proper connections through the desk. It also should have a small number of service observing lines, jacks for listening to each operator in the exchange, and instruction circuits to the switchboard. The apparatus allows the chief operator to become familiar with the work of all her operators and to handle such special calls as the public may demand of her.

The information desk is the desk where all information regarding subscribers' numbers, such as is published in the directory, may be given to such subscribers as are unable to obtain a directory, or give information not yet published in the directory. Such other information as the management may desire can be given from the desk. The equipment consists of incoming trunk jacks and signals and answering cords and keys, together with the proper telephone circuits. The desk should also be equipped with card catalogue files.

The complaint desk is similar in equipment to the information desk and is used for receiving and recording all complaints of service or trouble and the segregating and forwarding of service complaints to the chief operator and trouble complaints to the wire chief.

The trunk distributing desk is used for grouping a portion of the trunks incoming from each of several exchanges on to one position when the load is light. Its equipment is usually a few jacks and plugs and cords, the incoming trunks from the distant office to end on one and the trunks going to the "B" board to end on the other.

The service observing desk has equipment for placing of several subscribers' lines on the desk, allowing the attendant to listen on any line when signals show that operator or subscriber is using the line. This allows of the actual service being given to be determined.

In conclusion, a few words about the traffic load curve may be of interest. Our load curve is of similar nature to that of an electric light or street railway plant. Four peaks may be noticed, one from nine to eleven a. m., one from two to four p. m., one from five to six p. m., and one after seven in the evening. In most exchanges the morning peak is the higher, provided it has business telephones to any extent.

The hours vary on different days, but usually will be as given.

THE VICTORIA FALLS POWER TRANSMISSION PROJECT.

According to an official pamphlet recently issued by the British South African Company, who are the promoters of the Victoria Falls Power Company, Ltd., the main feature of the scheme is the generation by hydraulic power of electrical energy at the Victoria Falls and its transmission at 150,000 volts pressure to the Rand—a distance of 700 miles. The initial installation of machinery proposed is for the production of 50,000 horsepower.

As an integral part of the complete installation, the engineers have advised the erection on the Rand of a 24,000-horsepower steam-driven generating station and a system of hydraulic accumulation patented by Mr. Wilson Fox.

The object of the accumulator system is to pump water into high-level reservoirs during times of low demand for power, and to use it for the reproduction of power when required, the capacity of the reservoirs to be adequate for a twelve hours' supply. To do this, necessarily involves additional water turbines and generating plant at the Rand end of the transmission line.

The object of the steam-driven plant is to act as a stand-by in case of temporary interruption of current from the Falls. At present a tentative suggestion is made to the effect that the company may ultimately adopt three-phase transmission at the pressure of 150,000 volts and a frequency of 12.5 periods, the conductors being carried on steel towers about 60 feet high and spaced 1,000 feet apart.

STATION RECORDS.

Lecture Delivered to Class in Electrical Engineering on February 27, 1907, by Mr. J. D. Ross at the University of Washington, Seattle, Wash.

(*Continued from last issue.*)

All work orders are made in duplicate, one copy being left in the book for file. In the case of outside work cards the copy kept on file is the original and is made of thinner material to make copying easy. In order that an account of the depreciation and operation of apparatus may be carefully determined, a card index system should be kept, giving the life history of the apparatus from the time it is purchased until it is relegated to the past. These are especially suitable for records of transformers, motors, arc and Nernst lamps and meters. All changes, repair material, and labor can be charged on these cards with very little trouble.

THE CITY OF SEATTLE LIGHTING AND WATER DEPT.

WORK ORDER

LIGHTING

L. B. YOUNGS SUPERINTENDENT

No. W. 9 3 DATE__________190___

Please do the following.

Charge _____ Amount _____

" Labor "

Material "

Signed________________

RENEWAL RECEIPT

Address ________________ Name ________________

Received of THE CITY OF SEATTLE, LIGHTING DEPARTMENT the following new lamps:

____2 C. P. ____4 C. P. ____8 C. P. ____16 C. P. ____32 C. P., which are to replace ____2 C. P. ____4 C. P. ____8 C. P. ____16 C. P. ____32 C. P. burned out lamps.

____herewith return ____ C. P. ____C. P. good lamps and in place of them hereby acknowledge receipt of ____ C. P. ____ C. P.

________________ ________________

Seattle____________190___ ________________

Full information as to location, nature of inspection or service must be given.

Approved:

....

....

OFFICIAL TITLE

This statement must be filed with and approved by the head of the department daily.

V. B. 389—5M.

BANK________ TRANSFORMER RECORD NO.________

CITY OF SEATTLE, LIGHTING DEPARTMENT

LOCATION________________

POLE NO.____ POLE OWNER ____ MAKE____ FACTORY NO.____

TYPE____ SECONDARIES {VOLTAGE ____ WIRE____} OIL FILLED____

DATE PUT UP____190_ DATE TAKEN DOWN____190_ PURCHASED____190_

DATE			REMARKS
MONTH	DAY	YEAR	

MOTOR RECORD NO.________

CITY OF SEATTLE, LIGHTING DEPARTMENT

HISTORY OF MOTOR {MAKE____, TYPE____ SIZE____ H. P., AMP.____; ____C. VOLTAGE____, PHASE____, FACTORY NO.____; STARTER NO.____, STARTER MAKE____; OWNED BY____, PURCHASED____190__}

DATE			REMARKS
MONTH	DAY	YEAR	

NO.________

ARC LAMP RECORD

CITY OF SEATTLE, LIGHTING DEPARTMENT

HISTORY OF ARC LAMP {MAKE ____ FACTORY NO.____ FORM____; CLASS____ STYLE____ FINISH____ AMPERES____}

PURCHASED________190__

DATE			MAINTENANCE		DATE			REMARKS
MO.	D	YR.	AMT.	TROUBLE	MO.	D	YR.	

NERNST LAMP RECORD No.________

CITY OF SEATTLE, LIGHTING DEPARTMENT

HISTORY OF NERNST LAMP {TYPE____GLD. VOLTS____ AMP.____ FINISH____CAT. NO.____; SHADE____ GLOBE____ HEAT. DADE____ BALL____}

PURCHASED________190__

DATE			MAINTENANCE		DATE			REMARKS
MO.	D	YR.	AMT.	TROUBLE	MO.	D	YR.	

NO. ....

METER RECORD

CITY OF SEATTLE, LIGHTING DEPARTMENT

HISTORY OF METER {MAKE .... FACTORY NO. .... TYPE ....; FORM .... CLASS .... WIRE, AMP. .... VOLTS .... MULT........}

PURCHASED ....190.....

DATE			REMARKS
MONTH	DAY	YEAR	

ADDITIONAL INSTALLATION. LAMP RECEIPT No. ....

Address .... Name ....

RECEIVED OF THE CITY OF SEATTLE LIGHTING DEPARTMENT.

.......4 C. P. ....8 C. P. ....16 C. P. ....32 C. P. ....1 Gl. ....2 Gl.

.....3 Gl. ....5 Gl ....6 Gl ....Amp. Arcs .....Amp. Arcs ......Amp. Arcs

Lamps, which are to be used only with current supplied from the City's circuits, at above address. The undersigned agrees to return the above number of lamps with glass intact, when the City's service is discontinued; and further agrees to pay for all lamps not so returned, and for all lamps broken, at 30 cents each for 32 C. P. and 20 cents each for 4, 8 and 16 C. P., and for Arcs and Nernst lamps at the market prices for same when lost or broken.

....

Seattle.............................190... ....

Date__________

Address__________

M __________

Please notify your wiring contractor that the following protective devices are required before City Meter can be installed:

________wire main line cutout. ________wire main line switch.

________wire ________branch blocks. ________Amp. fuses.

____

__________ CITY LIGHTING DEPT.

__________ by__________

ORIGINAL INSTALLATION. LAMP RECEIPT No.______

Address__________ Name__________

RECEIVED OF THE CITY OF SEATTLE LIGHTING DEPARTMENT

____4 C. P. ____8 C. P. ____16 C. P. ____32 C. P. ____1 Gl. ____2 Gl.

____3 Gl. ____5 Gl. ____6 Gl. ____Amp. Arcs ____Amp. Arcs ____Amp. Arcs

Lamps, which are to be used only with current supplied from the City's circuits, at above address. The undersigned agrees to return the above number of lamps with glass intact, when the City's service is discontinued; and further agrees to pay for all lamps not so returned, and for all lamps broken, at 30 cents each for 32 C. P. and 20 cents each for 4, 8 and 16 C. P., and for Arcs and Nernst lamps at the market prices for same when lost or broken.

__________ __________

Seattle,__________190__ __________

CITY OF SEATTLE LIGHTING DEPT. ROUTE______ CARD______

ADDRESS __________

NAME __________

ACC'T NO.______ METER______ AMP.______ VOLTS______

MULT.______ INSTALLED______190____ MAKE______

LOCATION __________

YEAR 190__	DAY	READING	DIFFERENCE	MAX METERS		CALLED
				NUMBER	READING	

City of Seattle
Requisition on Storekeeper

No......... Date.......................................1907

Municipal Light & Power Plant

Please deliver the following material:

QUANTITY	MATERIAL
For	

__________ *Foreman*

I have a number of miscellaneous cards which are mostly self-explanatory. I have grouped these into several groups instead of showing them separately.

The lamp receipts are made out for original and for additional installations. Where a customer supplies his own lamps this is of course unnecessary.

The requisition on storekeeper and the tool slip show our method of keeping the stock room straight. Our stock-keeper also keeps a daily detailed record in a stock book for the purpose.

In meter work we find that customers sometimes have an installation that is not ready for a meter, and we issue a slip stating exactly what is needed from his contractor.

In case customer is not at home a slip is put under the door, giving the time when meter reader will call again. This has also the effect of convincing the customer that the reader has called at the proper time.

The meter test cards are self-explanatory.

The time slips and expense accounts have been mostly copied from the City Engineer's department, and are filled out each day so that the time may be charged to the proper account.

TOOL SLIP

....190....

Received of

Seattle M. L. & P. P.

*One*__________

....

Same to be returned or charged to my account,

____

VA—320—2M-2-05.

THE CITY OF SEATTLE

LIGHTING DEPARTMENT

DAILY EXPENSE SLIP

OFFICIAL POSITION

....

....

For...190.....

Where and What For	Amount	
....	....	....
....	....	....

LIGHTING DEPT.

DAILY TIME SLIP

..................................Crew No..............

Foreman..190.....

NAME	Inst.P.Const.	Inst. P. Oper.	Inst.Lt.Const.	Inst. Lt.Oper.	C. Lt. Const.	C. Lt. Oper.	St.Crt.Const.	St. Crt. Oper.	P.Line Const.	P. Line Oper.	TOTAL TIME
Totals											

Time must be turned in on this slip each day. No time allowed unless on this sheet.

VB430 4006 80DK550EA DPCO

.... Date........................190.....

Do not write on this line.

Mr. J. D. Ross: The following trouble has been reported to me:

At.. *Phone*......................

Customer's name ....

Trouble ....

....

....

Signed ....

TEST METER

For..

At..

Date....................*No*....................*Reading*....................

Type....................*Amp*....................*Multiplier*....................

Volts	*Rev.*	*Sec.*	*Met. Reg*	*S'd Reg*	*% F*	*% S*
....	....	....	....	....	....	....
....	....	....	....	....	....	....

METER AS LEFT

....	....	....	....	....	....	....
....	....	....	....	....	....	....

TIME SLIP

LIGHTING

DATE..................................190...

NAME..

POSITION ....

....DIVISION

Work Order Number	DESCRIPTION OF WORK	Hours	Minutes

THE ABOVE IS CORRECT

Form V. B. 437. 5 M, 11-7-06 SIGNED....................................

CITY OF SEATTLE

LIGHTING AND WATER WORKS DEPARTMENT.

Expenses of..

(Official Position)..

Month of..

DATE	AMOUNT		ORD. NO.	LID NO.	REMARKS
					Total Amt. for Month, $

I HEREBY CERTIFY that the above amount of..............................

expense is a just claim against the City of Seattle.

....

....

V. B. 42:8 1-06. 1M.

Quantity of	Material Used	Dollars	Cents
....	Feet No.............Wire..........	......	......
....	Feet No.............Wire..........	......	......
....	Feet Twin Cable..........	......	......
....	Wood Pins..........	......	......
....	Iron Pins..........	......	......
....	Wood Steps..........	......	......
....	Iron Steps..........	......	......
....	Glass Insulators..........	......	......
....	Porcelain Insulators..........	......	......
....	............Circuit Breakers..........	......	......
....	............Circuit Breakers..........	......	......
....	Brady Cutouts..........	......	......
....	Iron............Brackets..........	......	......
....	Eye Bolts..........	......	......
....	......" x......" Bolts..........	......	......
....	......" x......" Bolts..........	......	......
....	......" x......" Lag Screws..........	......	......
....	Feet Rope..........	......	......
....	Rope Cleats..........	......	......
....	.......pin Cross Arms..........	......	......
....	.......pin Cross Arms..........	......	......
....	Cut Washers..........	......	......
....	Cast Washers..........	......	......
....	Cross Arm Braces..........	......	......
....	Junction Switches..........	......	......
....	Fuse Blocks..........	......	......
....	Angle Arm Braces..........	......	......
....	Crosby Clips..........	......	......
....	....	......	......
....	TIME..........	......	......
....	Hours Foreman..........	......	......
....	Hours Lineman..........	......	......
....	Hours Repair Men..........	......	......
....	Hours Ground Men..........	......	......
....	Hours Team..........	......	......

The trouble slips are important. One point to be noticed is the space for customers' signature. If this is got when a troubleman makes repairs it shows that he is satisfied, and prevents him from misrepresenting or denying that the work has been done.

The contract blanks are so nearly similar in all plants that I shall not touch on this point.

SHOOT TROUBLE

At ....

For ....

Reported........ *a. m.* *p. m.* ....190....

....

....

....

Delegated to ....

Report ....

....

....

....

....

....

Repaired .... *a. m.* *p. m.* ....190....

Signed .... *Customer*

Signed .... *Troubleman*

V. B. 449-12-27-06-2M

FILAMENTS FOR INCANDESCENT LIGHTS.

Carbon filaments for incandescent lamps are made either from cotton threads parchmentized by action of sulphuric acid, afterward drawn to uniform cross section and finally carbonized, or from cotton wool dissolved in zinc chloride solution which is forced through a small aperture into alcohol where it sets in the form of filaments. These are heated until carbonized. The latter can stand more current and have a longer life. The latest advance is a filament devised by Professor Parker, of Columbia University, to which the name "helion" has been applied, on account of its sunlike light. It is reported to be a carbon filament impregnated or covered with silicon, of great resistance and durability and capable of soldering its parts together at a break. Selective radiation is claimed for it. It is said that it emits white light at a temperature at which carbon is only red hot.

THE TUNGSTEN LAMP.

The fusing point of tungsten is about 2,500 degrees Centigrade, which enables it to operate at the high efficiency obtained in the tungsten lamp. An 85-candlepower tungsten lamp consumes 105 watts, less than one and one-half watts per candlepower. An ordinary incandescent lamp consumes three and one-half watts per candlepower. The life of the new tungsten lamp is approximately 1,000 hours, and it appears to be equally good on direct or alternating current.

Tungsten does not seem to be ductile, and unites readily with oxygen and carbon at high temperatures. Making a tungsten filament has been a difficult problem, but has been successfully done by several processes.

VALTELLINA ELECTRICAL RAILROAD.

The Valtellina Railroad in Italy is using electric power exclusively for the regular traffic on long distance. The electrical installation was carried out by Ganz & Co., Budapest. The current is three-phase alternating; the line has two parallel overhead wire conductors and has the third phase carried in the rails. The length of the road is 67 miles, of which 30 per cent is in tunnels, and nearly 50 per cent of the full length of the road is composed of curves. The maximum grade is 2 per cent, and the minimum radius is 1,000 feet. The road is laid with 80-pound rails placed on impregnated wooden ties, the rails being bonded with copper at the joints to provide for good electric conduction. The electric locomotives weigh 51 tons and have four motors of 150 horsepower each, using current of 3,000 volts. The ordinary passenger trains consist of one motor car and four to five ordinary passenger cars. The speed is from 40 to 45 miles an hour, which is maintained even on grades up to 1 per cent. The locomotives in freight traffic pull trains of 280 tons with a speed of 40 miles per hour, and 440-ton trains with a speed of 22 miles per hour.

The energy necessary per ton mile has been found to be with full speed on the level from 18 to 20 watt hours and in heavy grades from 34 to 55 watt hours. When starting a train to a speed of 40 miles per hour during a time of two minutes, about 150 watt hours per ton of train weight is necessary. The average energy required measured at the power station is 73 watt hours per ton mile, but in this is included all current used for heating, lighting, for the power required for the railway shops and all losses. At the power station the maximum load is nearly 2,000 kilowatts, but the average load is only 700 kilowatts, slightly more than one-third of the maximum. The cost for the electrical installation is shown in the table below:

Power station	$600,000
Main conductors and transformers....	200,000
Working conductors	360,000
Ten motor cars, each $24,000..........	240,000
Five locomotives, each $20,000.........	100,000
	$1,500,000

The cost per mile is thus about $22,400 for the electrical installation alone. The operation costs for 1904 amounted to $300,000. The passenger fares are those common for express train service in Italy, which is 1.6 and 3.8 cents per mile, respectively, for third and first class. This installation is particularly interesting, as it has proven the practical possibility of using the same train system for electricity as for steam on comparatively long distances. It has proven that electrical locomotives in all respects may replace the steam engines, and that the future of electricity for railroad power generation wherever the power can be had cheaply, that is, where waterpower is available, is secured.—Teknisk Tidshrift.

RECENT ADVANCES IN IRON-ORE SMELTING.

Under the conditions which obtain in most of the settled portions of the world, neither pig iron nor ordinary structural steels can be produced in the electric furnace at a cost to compete with the blast furnace. Under exceptional conditions, where ample water power can be very cheaply developed near the ores, while fuel is very dear, pig iron and steel can be produced profitably in the electric furnace. Harbord estimates that with electrical energy costing $10 per electrical horsepower-year, and with coke at $7 per ton, the two methods are about on an equality. Electrical methods may be practicable in the case of titaniferous ores, or other ores difficult to treat in the blast furnace, if the resulting product possesses any properties which would counterbalance the increased cost. They can also be profitably applied to the manufacture of crucible steel, or other high-grade special steels and ferro-alloys.

FIRST COST OF MECHANICAL vs. CHIMNEY DRAFT.

It is difficult to make a general comparison of the first cost of a chimney with that of a mechanical-draft plant, because most chimneys for power plants are usually put up to obtain a draft from 0.5 to 0.75 of an inch of water, while mechanical-draft systems are seldom installed except to give a draft of at least one inch. It is probable that most chimneys are between 100 and 150 feet high, while a chimney to give a draft of one inch would have to be between 175 and 200 feet high, and the cost of a chimney increases very much as the height is made greater than about 125 feet. Moreover, for a large power plant several small steel chimneys are often put up instead of one large brick chimney, and these chimneys may be of cheap steel construction, so that the cost may be small. While a tall chimney to give a high draft costs more than a low chimney to burn the same quantity of coal under a low draft, a fan to supply air for a given quantity of coal under a high draft costs less than a fan for the same quantity of coal under a low draft. A low draft, however, means a low rate of combustion per square foot of grate surface, and hence a large area of grate in order to burn a given quantity of coal per hour, and it means, also, an almost total inability to burn coals of very low grade; while a high draft means a rapid combustion per square foot of grate surface, and hence a small grate to burn a given quantity of coal per hour, and also the ability to burn cheap coals of low grade.

A chimney to give a draft of 0.75 of an inch must be about 125 feet high, and one to give a draft of 1.5 inches would probably have to be at least 250 feet high. The cost of the higher chimney would be so very much greater than that of the lower that few engineers would recommend it solely because of the greater draft which would be maintained with it. In the case of a mechanical-draft apparatus, however, the apparatus to supply the air for the combustion of a given quantity of coal per hour under a maximum draft of 0.75 of an inch would be larger and cost more than the apparatus to supply the air for the combustion of the same quantity of coal under a maximum draft of 1.5 inches. The diameter of the fan wheel for the higher draft would be about 0.83 of the diameter of the fan wheel for the lower draft, and the dimensions of the engine, assuming it to be direct-connected to the fan, might also be smaller for the higher draft. The work done in running the fan for the higher draft would be twice as great as that for the lower, and hence the running expenses would be almost twice as great, but, even then, the running expenses would be small. Thus, to supply air for the combustion of 5,000 pounds of coal per hour with an economizer under a maximum draft of 0.75 of an inch of water, an induced mechanical draft apparatus would require a fan with a seven-foot wheel; while, to supply air for the combustion of the same quantity of coal under a maximum draft of 1.5 inches, a fan with a wheel six feet in diameter would be more than ample, and a five and one-half-foot wheel would be almost large enough. The seven-foot fan would have to be run at a speed of 195 to 200 revolutions per minute and would require a direct-connected engine having a cylinder six inches in diameter with an eight-inch stroke; while the six-foot fan would have to be run at a speed of about 325 revolutions per minute, and an engine having a cylinder six inches in diameter and an eight-inch stroke would be more than ample for it, because of the greater number of revolutions made per minute. The dimensions of the engine are based upon the supposition that the boiler pressure would be at least 100 pounds. This example illustrates the curious anomaly in regard to the difference between a chimney and a mechanical-draft plant. In the case of the chimney the consideration of the first cost makes the engineer keep the chimney as low as possible and get along with as low a draft as possible; while, in the case of a mechanical-draft apparatus, the consideration of first cost makes the engineer keep the draft as high as possible. The running expense is what makes the engineer keep the draft given by a mechanical-draft apparatus low, but the running expense is usually more than offset by such advantages as the ability to burn cheaper fuel and to maintain a hotter fire in the furnace, thus securing that more perfect combustion for poor fuels which always attends a high draft. It is seldom that a mechanical-draft system is installed to give a draft no greater than would be likely to be given by a chimney, and hence the higher draft capable of being obtained with the mechanical-draft apparatus must be carefully borne in mind when considering the first cost. It is possible, of course, to put up one or more cheap chimneys for a power plant and make the cost of them less than the cost of a properly-designed mechanical-draft system, but it is probable that in most cases a lined, self-supporting steel chimney or a brick chimney will cost considerably more than a mechanical-draft apparatus capable of furnishing air for the combustion of the same quantity of coal per hour, and further, capable of giving a higher draft than the chimney. When, because of local conditions, it is necessary to discharge the gases of combustion at a considerable height, 100 to 150 feet above the ground, the mechanical-draft apparatus plus the chimney for discharge of the gases, may cost even more than a chimney alone that would be capable of furnishing at a low draft the air required for the combustion of the coal; but if the draft required be at all high, it is probable that, even under these circumstances, the cost of a suitable mechanical-draft apparatus would be less than that of the chimney.

SUMMER SCHOOL FOR ARTISANS AT THE UNIVERSITY OF WISCONSIN.

The seventh annual session of the Summer School for Artisans, held under the direction of the College of Engineering of the University of Wisconsin, begins June 24th, and continues for a period of six weeks. Courses of study are offered in the following subjects: Engines and Boilers.—Lectures and laboratory courses covering the theory, construction, management and testing of steam engines, boilers, gas engines and gas producers, refrigerating machines. Applied Electricity.—Lectures and laboratory courses covering the theory of direct and alternating current dynamos and motors, the operation and method of testing electrical machinery, batteries, transformers and other apparatus, photometry, and calibration of instruments. Mechanical Drawing and Machine Design.—Elements of applied mathematics, courses in mechanical drawing and machine design adapted to the preparation of the students. Materials of Construction, Fuels and Lubricants.—Lectures on the properties of materials accompanied by laboratory tests; lectures on fuels and lubricants with laboratory tests on the heating value of coals and efficiency of lubricants. Shop Work.—Practice with hand tools, wood and metal working machinery, and in blacksmithing and pattern making. Manual Training.—Lectures and laboratory courses adapted to the requirements of manual training teachers. The requirements for admission do not extend beyond a working knowledge of English and arithmetic, but the policy is to allow a large amount of individual work so that the student may take advantage of all the preparation he has obtained. This school offers to those unable to take a regular four years' course an opportunity of obtaining a working knowledge of the methods of testing, and the use of instruments, together with such theoretical principles in each case as the nature of the subject and the preparation of the student may permit.

APPROVED ELECTRICAL DEVICES.

This department from time to time will contain an illustrated description of all fittings approved by the Underwriters' National Electric Association.

MISCELLANEOUS.

BESSELECTRIC CIGAR LIGHTS.

For us on circuits of not over 125 V. A small igniting coil imbedded in a porcelain disc and provided with a suitable cut-out switch and handle. Approved Jan. 3, 1907. Manufactured by

The Besselectric Light Co., Scranton, Pa.

KNOSTRAIN INSULATING BUSHINGS.

A composition insulating bushing for sockets, rosette-caps, etc., designed for reinforced flexible or ordinary lamp cord. Approved Feb. 7, 1907. Manufactured by

Frank H. Stewart Electric Co., Philadelphia, Pa.

"O. K." ground clamp. A copper band with lug for soldered connections and screws for tightening. In sizes ½ inch to 3 inches. Approved March 13, 1907. Mfd. by

The Pettingel-Andrews Co., Boston, Mass.

STEWART AUTOMATIC, HIGH VOLTAGE CUT-OUT DEVICE.

An iron and slate case enclosing link fuses and automatic switch for short-circuiting the service line, the latter operated by means of magnet in event of excess voltage on line. Approved Jan. 7, 1907. Manufactured by

S. J. Stewart, New Orleans, La.

PANELBOARDS.

N. E. Mfg. Co. 125-250 V.; type A, 2-wire; type B, 2-wire; type C, 3-wire. Approved Jan. 29, 1907. Mfd. by

The Newport Electric Mfg. Co., Newport, Ky.

"Universal." 2-wire, 125 V.; 3-wire, 250 V. For Edison plug fuses, with or without branch circuit switches. These boards have rings formed in the branch bus-bars to serve as receptacles for fuses. Approved Feb. 8, 1907. Mfd. by

J. Lang Electric Co., Chicago, Ill.

PROTECTORS, TELEPHONE.

"Noark." Approved March 4, 1907. Manufactured by

The Johns-Pratt Company, Hartford, Conn.
The H. W. Johns-Manville Co., New York, N. Y., Sole Agents

RECEPTACLE, STANDARD.

"Benjamin," 3A, 250 V. Cat. No. 6B, for outlet boxes, with or without cover. Approved Jan. 10, 1907. Manufactured by

Benjamin Electric Mfg. Co., Chicago, Ill.

G. E. Flush receptacle and plug, 10A, 125 and 250 V. Cat. No. 33,441. Approved Jan. 31, 1907. Manufactured by

General Electric Co., Schenectady, N. Y.

P. & S. Cat. Nos. 2371, 02371, 237, 0237, 247, 0247, 1087, 107, 971, 770, 670, 870, 871, 877, 1072, 973, 977, 777 and 577, with removable porcelain ring. Weatherproof types. Cat. Nos. 1160, 1161, 972 and 974, 250 V. Approved Mar. 4, 1907. Manufactured by

Pass & Seymour, Solway, N. Y.

RECEPTACLE, STANDARD, SUB-BASE.

P. & S. Cat. No. 1162. A round porcelain piece for use with weatherproof receptacles Nos. 1160 and 1161. Approved Mar. 4, 1907. Manufactured by

Pass & Seymour, Solway, N. Y.

RHEOSTATS.

Ward-Leonard. FF and FB types field rheostats, 50-600 V.; KRE, HRE, KVE and HVE types speed control rheostats, 100-600 V.; BD, SD and IBD types theater dimmers, 125 and 250 V. Also SKE., ESKE, ESVE, SIK, and SVE types motor starting rheostats, 125-500 V. Approved Jan. 14, 1907. Manufactured by

Ward-Leonard Electric Co., Brontzville, N. Y.

ROSETTES, FUSELESS.

Fielding. Cleat, concealed and moulding types. Nos. 433, 435, 436, 437, 438, 441 and 480. Approved Feb. 13, 1907. Manufactured by

H. T. Paiste Co., Philadelphia, Pa.

"Peru," cleat types. Cat. Nos. 985, 986, 7422 and 7421, with porcelain sub-base; concealed type, Cat. No. 987; porcelain tie buttons, concealed and moulding types, and porcelain tie button and cleat, improved type. Approved Apr. 1, 1907. Manufactured by

Peru Electric Mfg. Co., Peru, Ind.

ROSETTES, LINK FUSE.

M. S. Cleat type. Cat. No. 950. Approved Apr. 9, 1907. Manufactured by

Marshall Electric Mfg. Co., Boston, Mass.

SOCKETS, WEATHERPROOF.

Knowles' porcelain weatherproof socket, 250 V., 50 C. P. Approved Jan. 10, 1907. Manufactured by

C. S. Knowles, Boston, Mass.

P. & S. Pendant style, Nos. 116, 117. Bracket style, Nos. 0116½ and 116½. Approved Jan. 3, 1907. Manufactured by

Pass & Seymour, Solway, New York.

Trumbull porcelain weatherproof socket, Cat. Nos. 978, 250 V., 50 C. P. Approved March 25, 1907. Manufactured by

Trumbull Electric Mfg. Co., Plainville, Conn.

SWITCHES, COMBINATION CUT-OUT.

"Noark," 61-600A, 250 V. Two and three-pole. An iron box containing standard cartridge fuses, with device for withdrawing fuses from clips when cover of box is opened. Approved Mar. 4, 1907. Manufactured by

The Johns-Pratt Co., Hartford, Conn.

The H. W. Johns-Manville Co., New York, N. Y., Sole Agts.

"Paiste" knife switches with cartridge fuse cut-out extension, 0-30 and 31-60A, 250 V., two and three-wire. Approved Apr. 9, 1907. Manufactured by

H. T. Paiste Co., Philadelphia, Pa.

SWITCHES, KNIFE.

"Krantz"—all capacities, 125 and 250 V., with or without open-link fuse extensions, front or back connected. Approved Apr. 9, 1907. Manufactured by

H. Krantz Mfg. Co., Brooklyn, N. Y.

"Premo"—all capacities 250 V., 25, 50, 75 and 100A, 500 V., with or without standaid cartridge fuse extensions. Approved Feb. 7, 1907. Manufactured by

The Barkelew Electric and Mfg. Co., Middletown, Ohio.

"Trio"—(formerly Tornquist), 25, 50, 75 and 100A., 250 V., with or without standard enclosed fuse cut-out extensions; also 15A., 125 and 250 V., single-pole, double-pole and three-way, single and double throw. Approved Feb. 26, 1907. Manufactured by

Trio Manufacturing Co., Rock Island, Ill.

SWITCH BOX.

"Fancleve." An iron supporting box for surface snap switches, for use with wooden moulding. Approved Apr. 2, 1907. Manufactured by

John L. Gleason, Jamaica Plains, Mass.

"Fancleve." A cast-iron conduit switch and outlet box. Approved Jan. 10, 1907. Manufactured by

John L. Gleason, Jamaica Plains, Mass.

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EASTERN AGENCIES

NEW YORK ....
CHICAGO ....
ST. LOUIS ....

WESTERN AGENCIES

LOS ANGELES ....
PORTLAND ....
SEATTLE ....

Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," with which is incorporated "The Engineers', Architects' and Builders' News."
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Entry changed to "The Journal of Electricity," September, 1895.

VOL. XVIII MAY 11, 1907 No. 19

EDITORIAL.

SAN FRANCISCO'S INDUSTRIAL FUTURE

It is doubtful if there is a city in the world inhabited by supposedly intelligent people which is in the abominable condition of San Francisco today. It is not the intention of the "Journal" to indicate upon whom the blame should be placed or to take sides in the controversy which has been practically continuously carried on for more than five years in this city between the interests representing labor and the interests representing capital. San Francisco's future, however, is threatened. Its geographical position gives it a tremendous advantage over any other city on the Pacific Coast. It must carry on work in certain lines of business under any and all conditions. These lines of work, however, are purely commercial. A large portion of the entire State of California, either directly or indirectly, has San Francisco for its market and business center. Nevertheless, unless conditions are improved, the position of supremacy, in which San Francisco, notwithstanding the earthquake and fire, stands today as the metropolis of the Pacific Coast, will and must pass to some other city, inhabited and controlled by saner people.

Those interested in engineering and engineering enterprises may well give the situation careful study. The proper remedy must be found and speedily applied. Every citizen of San Francisco, and indirectly every person in the State, must appreciate what the ultimate result will be if the present conditions are allowed to continue. Substantially all of the extraordinary progress of our State, as well as our country, in fact of the entire civilized world, which has taken place during the last decade, and particularly since the revival of industries in the early seventies, has been affected through the adoption of scientific systems, as well as the introduction of universal and cheap transportation. The great economic question of today in every State and in every nation, for all time to come, is, "How shall the industries be most effectively sustained and promoted as a basis for all moral, intellectual and material advancement?"

The answer is that the needful thing is industry scientifically utilized and properly rewarded.

The industrial world is one in which the human hand and brain working to a common end find ingenious mechanical combinations and discover new methods by which the labor assisting machine may be made to do the work of the world more completely, and thus reduce the working time and lighten the labor of the people, permitting the rapid accumulation of wealth in forms of permanent value. The work of agriculture even is beginning to be a world of mechanics, and its people are more and more segregating where they find life most attractive, and they are constantly finding ways of securing for themselves and their children comfort, competence, education and freedom from anxiety as a result of their industry, physical effort and mental ability.

All over the country, however, and especially in San Francisco, there has been developed a serious class prejudice which is preventing the proper co-operation in the work of the human hand and its necessary working partner, Capital, intelligently directed. Within recent years, largely on account of cheap power, San Francisco has had visions of the possibility in the future of becoming a great industrial center. If, however, what the public press indicates is true, namely, that there are now more than twenty-five thousand persons unemployed because of strikes, the attitude which men of affairs must of necessity take cannot result in the future upbuilding of San Francisco as an industrial city.

The impression that the stranger would receive on lower Market Street today should shame every loyal San Franciscan. Two great public utilities—the street railway lines and the telephone system—are both closed down on account of striking employes. About nine thousand machinists are out, shutting down many important machine shops in the city. San Francisco's greatest manufacturing plant—the Union Iron Works—will probably never again be operated as it was a few years ago, when the famous battleship "Oregon" was constructed at these works. In addition, everyone is inconvenienced by the closing down of practically all the laundries on account of labor troubles. Little effective and efficient work is being done in any line, and all construction is costing from twenty-five to fifty per cent more than should be the case on account of the abnormal cost of really efficient labor, as well as material, and all this with no specific reason, except

perhaps that which may be truthfully called class hatred and personal greed.

San Francisco's friends who so nobly stood by her a year ago, and who have repeatedly expressed admiration for the grit shown by her people in the rebuilding of the city, cannot but condemn her for the present situation. Our future is at stake. Whatever the real cause is, it must be removed. One cannot but hope that no matter how serious the present street car strike may be, a permanent settlement will result in the very near future of all of San Francisco's labor and capital troubles.

THE ILLUMINATING ENGINEER.

On Friday evening, May 3d, a large number interested in illumination met at the assembly hall of the Pacific Gas and Electric Co., San Francisco, to organize a local branch of the Illuminating Engineers' Society. The minutes of the meeting are here printed in full, and will be followed in a subsequent issue by an article on the objects of the Association:

Meeting was called to order at 8:30.

Mr. W. J. Miller was elected as temporary Chairman, and Mr. W. H. Crim, Jr., as Secretary.

Mr. Lansingh, manager of the New York branch of the Society, spoke at length on the purpose of this organization, and the method of organizing.

Mr. Barret, secretary of the San Francisco Gas & Electric Co., spoke on the importance of the Society, and urged those present to fill out applications, and induce their freinds of different professions, interested in the subject of illumination, to join.

At the request of the Chairman, the Secretary read the rules governing the various sections of the Society.

Nominations for two managers to be elected were as follows: Mr. Dolliver, Mr. Meyer, Mr. Roach, and Professor Corey. Then a motion was duly made to close the nominations.

Vote by ballot was taken, with the following result: Mr. Corey and Mr. Meyer being elected.

Motion was duly made and seconded that the chair, together with the other officers, appoint a committee for the purpose of increasing the membership of the San Francisco section. The motion was carried.

Mr. Barret and Mr. Marland spoke of the good that would come of the thorough knowledge of lighting, by architects and engineers, in obtaining the proper amount of illumination and still reduce the cost of power to consumers.

The chair called attention to the fact that through discussion on the lighting subject, architects might bring about satisfactory results of making the cost of installation, cost of power, etc., satisfactory to landlord, tenant, and lighting companies alike.

Mr. Lansingh suggested that the first three or four meetings should be taken on simple subjects, such as window lighting and artificial lighting of various rooms of residences.

Mr. Marshall also suggested the necessity of starting on simple lines in discussion, and observation of various kinds of lighting of the city, in order to familiarize the members with the subject.

Motion was duly made and seconded that when the required fifty applications were secured by the officers, the chair should apply to the Council for the necessary data to form the San Francisco section.

Mr. Barret offered the assistance of the clerical department of the S. F. Gas & Electric Co. to assist in sending out notices, etc.

The chair called for a meeting on Thursday, May 16th.

Motion was made and seconded that a vote of thanks be tendered to Mr. Lansingh, Mr. Marshall, and the San Francisco Gas & Electric Co., especially for the use of their assembly hall. The motion was carried.

The meeting adjourned at 10:30.

BOOK REVIEWS.

"Proceedings of the Thirteenth and Fourteenth Annual Meetings of the Pacific Coast Gas Association" contains a record of official business transacted, together with a number of interesting papers and discussions on problems of gas engineering. These have been printed from time to time in the columns of this journal, but are here collected together in compact and convenient form. The papers read include: "Gas Arcs," by W. M. Kapus; "The Spangenberg Meter," by E. C. Jones; "House Piping," by George Kirk; "The Compression and Transmission of Illuminating Gas," by E. H. Rix; "Something About Physics and Chemistry of Illuminating Gas," by F. C. Jones; "Utilization of Gas Engines in Connection with Long Distance Transmission," by John Martin; "Commercialism at Gas Association's Convention," by L. S. Bigelow; "Some Suggestion on Operation and Construction in the Electric Department," by G. C. Holberton; "Notes Regarding Gas Tar," by P. W. Prutzman; "The Public Corporation and the Municipality," by H. C. Brown; "Some Economics in High Pressure Gas Transmission," by E. H. Rix; "The Story of the Restoration of the Gas Supply in San Francisco After the Fire," by E. C. Jones; "How Electricity was Served to Consumers and Street Car Lines by the San Francisco Gas & Electric Company After the Fire," by L. E. Reynolds; "The Equity of the Sliding Scale," by F. H. Leach, Jr.; "Experiences with High Pressure Gas Mains," by Sherwood Grove; "Art of Canvassing," by John Clement; "Experiences with a Small Municipal Gas Plant," by C. E. Moore; "Large Gas Engines for Power Purposes," by J. E. Ane; "Gas Sales," by S. P. Hamilton.

PUBLICATIONS RECEIVED.

"Graphite" for April, 1907, from the Joseph Dixon Crucible Company of Jersey City, besides the usual interesting descriptions of graphite and its applications, contains the second installment on "Feeding Graphite for Lubricating Purposes," by W. H. Wakeman. There is also valuable information for automobile owners.

The Monthly Bulletin for April, published by the Ohio Brass Company of Mansfield, Ohio, contains an interesting article on "Catenary Construction on the Fort Wayne and Springfield Single-Phase Railway."

CATALOGUES RECEIVED.

The Fort Wayne Electric Works, of Fort Wayne, Indiana, send Bulletins No. 1086, Direct-current Series Enclosed Arc Lamps Differential Type Form C.; No. 1091, Direct-current Motors, Type EF, No. 1092, Type S Single-phase Motors, and No. 1093, Small-power Motors—Types GA and GD. These illustrated descriptions contain valuable information on each type of apparatus.

TRADE CATALOGUES.

Bulletin No. 1421 of the Allis-Chalmers Company, Milwaukee, Wis., illustrates and describes the Overstrom table for concentrating ores.

PERSONAL.

A. B. Vandercook, formerly in charge of Los Angeles branch of the Telephone and Electric Equipment Company, has succeeded R. L. Phelps as manager of the sales department of this company, with offices in the Union Trust building, San Francisco.

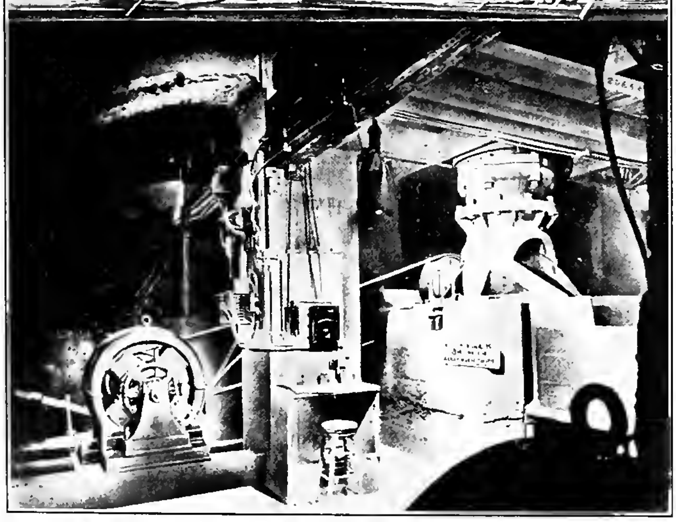
John D. Boyd of the Palo Alto municipal lighting plant was in San Francisco during the past week.

B. C. Holst, representing the California Electric Works in Nevada, is visiting the San Francisco headquarters.

INDUSTRIAL

A LESSON IN ECONOMY FROM NEW SAN FRANCISCO.

In the rebuilding of San Francisco, methods of economical leveling and construction have been sought out and practiced to a greater degree, probably, than at any other time and place in the world's history. As an instance typical of this, we may cite the work done on the Crocker building, standing at the corner of Post and Market streets, where

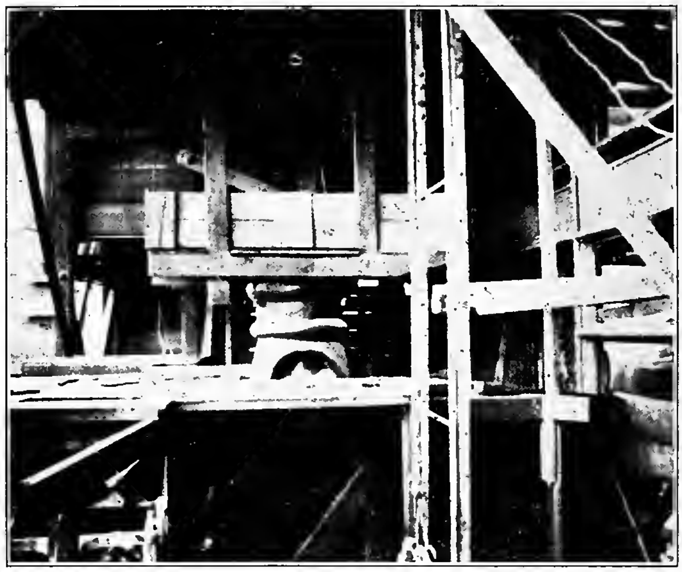


every avenue to waste, both of material and labor, has been most successfully closed through the exercise of a little ingenuity and forethought, aided by the best of modern crushing machinery.

This structure, which is ten stories in height, with a frontage of about 200 feet, escaped any serious damage from the earthquake, but was gutted by fire.

The frame of the building being intact, nothing more was necessary than a reconstruction of its interior, and the contractors at once hit upon the profitable plan of utilizing for concrete mixture all bricks, tiling, stone work and flooring which had to be removed. Suitable apparatus was therefore installed, and, as fast as the work of tearing down made this material available, it went directly to an Allis-Chalmers "Gates" Breaker, fed from bins supplied by chutes from various sections of the building. After being crushed to the desired fineness, the product of the breaker passed to a mixer, and as the concrete material issued from the latter, it was taken by a system of elevators and conveyors to all parts of the building where needed.

The significant feature of this process lies in the fact that, from the moment the material was taken from the walls and floors until the time it again became a part of the structure, there was not the slightest break or loss in its



handling. Of chief importance in this outfit is the breaker installed by Allis-Chalmers Company for the Roebling Construction Company, who state that they are very much pleased with the results obtained from it.

SHAWMUT POCKET TEST LAMP.

The accompanying illustration shows the Shawmut Pocket Test Lamp, a new device which the Chase-Shawmut Company has just put upon the market. The difficulty and annoyance which has occurred from defective indicators of enclosed fuses in general, necessitating the employment of cuit.

cumbersome methods to determine blown fuses, led the Chase-Shawmut Company to design a test lamp to be used as a short-cut method of discovering same. It is also useful to show whether or not a circuit is alive.

It is made up of a specially-designed incandescent lamp enclosed in a fibre casing. This casing has ferrules and knurled binding posts on either end, while at the middle a

fair-sized hole through both walls of the casing allows the illumination of the lamp to be plainly seen. For the majority of switches and fuses the metal ends of the test lamp will bridge the parts of opposite polarity, but for work where the distance is greater than the length of the test lamp the binding posts afford a convenient means of clamping leads of sufficient length. It is not designed for continuous service and should be used only for flashing, as the small enclosed casing will soon become too hot if left long in circuit.

THE WESTON MULTIMETER, MODEL 58.

The Weston multimeter is a new form of electrical measuring instrument which possesses a very wide range of usefulness in the measurement of electrical quantities. It will serve the purposes of a direct-current voltmeter, milli-voltmeter, ammeter, mil-ammeter, ohmmeter, ground detector and wheatstone bridge.

When used as a voltmeter, milli-voltmeter, ammeter or mil-ammeter, it is nearly equal in accuracy to any of the separate Weston portable direct-current instruments bearing those names and having substantially the same ranges. It differs from the regular forms in that a special movable coil is employed; which adapts it to better meet the several requirements of the combination of which the indicating instrument forms a part. The scope of measurements which may be made with the multimeter is large. It consists of a Weston type wheatstone bridge, a battery of twelve silver chloride cells, and an indicating instrument with detachable shunts.

The calibrated scale of the instrument has 160 divisions, with the zero (0) placed at 10 divisions from the end so that when the instrument is used as a galvanometer in connection with the bridge, both positive and negative deflections may be observed. The shunts are fastened in a compact form to a single base. They have binding screws, and can easily be connected to the instrument by flexible cables about six feet in length furnished with the instrument for that purpose. The shunts are constructed of Weston patent alloy having a negligible temperature co-efficient, so that the combination of instrument and shunt is practically free from errors due to changes in temperature.

The wheatstone bridge, which forms a part of the multimeter, consists of a rheostat with three groups of coils, adjusted respectively to units, tens and hundreds, aggregating 999 ohms, and a set of five ratio coils. Many novel features are embodied in its construction, and its design is such that compactness and durability are combined with convenience of arrangement, and an exceptionally high insulation resistance. All conductors and plug receptacles are placed under, instead of upon, the rubber top. This form of construction prevents any reduction in the insulation resistance, as the under side of the rubber plate is not exposed to the deteriorating effects of light, dirt and moisture.

The large area of conductors employed, their compact arrangement and the absence of all temporary or imperfect connection, together with the perfect fit of the five plugs, which are all that are required, make the "zero" resistance of the instrument less than that of any other portable bridge manufactured.

A push button is the only visible part of the double successive contact key, by means of which the galvanometer and battery circuits are made and broken.

A separate compartment in the case is provided for the battery, which consists of twelve cells connected together in series and fastened to a hard rubber top. A single cell may be used, or several in series. Any cell may easily be removed in case of necessity. Exhausted cells should be taken out, and if not replaced by others, the terminals to which they are connected should be short-circuited. Further particulars will be sent by the Weston Electrical Instrument Company of Newark, N. J.

THE STRAWBERRY VALLEY TUNNEL PROJECT.

Some of the most interesting engineering work is being prosecuted in connection with the Reclamation Service of the United States Coast & Geological Survey. One of the more recent of these undertakings has been inaugurated near Vernal, Utah, known as the Strawberry Valley Project.

This project includes the irrigation of several thousand acres of productive soil in the southern part of Utah County. A storage dam, having a capacity of about 100,000 acre feet, and reaching a height of forty-five feet, will be thrown across the Strawberry River. Water from this reservoir will be led through a tunnel more than three and one-half miles long to the distributing points, where it will be diverted into canals for irrigating the various ranches.

The construction of this dam will make possible the electrical development of a considerable water power, and a power house having a capacity of 2,250 kilowatts is contemplated. The power will be used not only for lighting various surrounding small towns, but for motor-driven centrifugal irrigating pumps.

A temporary power house will be erected at once at Spanish Fork, some thirty-three miles from the construction camp, so that electricity will be available for building operations. The electrical equipment will form the nucleus of the plant, which will eventually be installed on the Strawberry River.

The electrical equipment for this temporary power plant will be furnished by the General Electric Company. The initial apparatus, including two 425-kilowatt, three-phase alternating-current generators, direct connected to Leffel water wheels. The generators will furnish current at a potential of 11,000 volts to step-up transformers, which in turn will raise the voltage to 22,000 for transmission. Two belt-driven, 45-kilowatt generators will supply direct current at a potential of 125 volts for excitation purposes. Switchboard equipment will be provided for both the main station and two sub-stations.

At the sub-stations motor-generator sets will be installed for supplying direct current for hoisting motors and other purposes. The motor-generator sets consist of 75-kilowatt and 50-kilowatt direct-current machines, each direct connected respectively to a 157-horsepower and a 125-horsepower 2,080-volt induction motor. The shafts on the induction motors are extended to take pulleys from which air compressors are belt driven. The compressed air is used for driving rock drills. On account of the double duty which they perform, the induction motors are of the comparatively large capacity indicated.

Work on the tunnel has already started, but will be greatly facilitated when the temporary power house is completed, since the operations, up to the present, have been handicapped by the employment of small gasoline engines for power.

Following the defeat of municipal ownership at the recent election in Chicago, the Chicago City Railways Company has purchased of the General Electric Company, 1,200 direct-current railway motors with controlling apparatus for the operation of 300 new cars. Power for the new rolling stock will be supplied by additional electrical generating machinery aggregating 6,000 horsepower. Each car will be equipped with four 40-horsepower motors, this size of motor being the standard for urban railways.

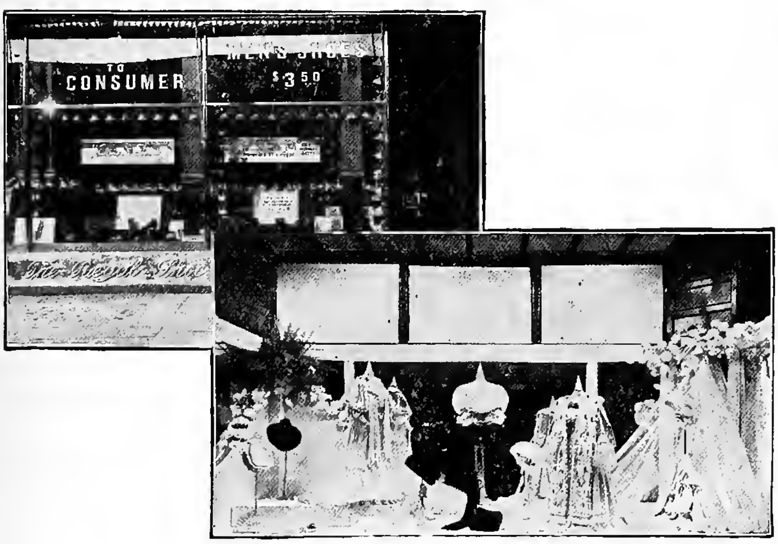
WINDOW LIGHTING.

This may be divided into two classes: (1) Where the lights themselves are the attraction. (2) Where lights are used to properly illuminate the goods displayed. In the first class come saloons and places where no goods are displayed, and the lights simply are used for attracting attention. Unfortunately, this method is often used where the result desired is to show the goods, as for example, where rows of bare incandescent and electric lamps form the border of a display window. Owing to their being in the line of vision, they fail lamentably in producing proper results.

A famous French scientist charges Americans with "caring as little for their eyes as they do for their stomachs." That there is a measure of truth in this statement cannot be denied.

People looking in the window often make the statement that the light is "hard on the eyes," which simply means that the source of light is too intense to be comfortably or safely looked at; this results in the loss of a large percentage of prospective customers.

The shrewd merchant has an eye for the comfort of every person that looks into his window. For a window where goods are shown, the light should be entirely hidden, and at the same time concentrated strongly on the goods displayed. When open flame illuminants furnished the only means of illuminating show windows, many a merchant said unto himself, "How can I set my goods so that the light will fall on them in the right way?" With the advent of electricity there came a change; the question the merchant asks himself now is, "How shall I place my lights so as to display my goods to the best advantage?"



The students of illumination were quick to seize upon this opportunity to display their ingenuity and have designed a reflector for use especially for window lighting. They can be used advantageously where the lights are placed either horizontally or vertically along the frames of the window. They have the advantage of not only concentrating the light strongly on the goods, but also protecting the eyes from the glare of the filament, thus allowing the use of clear lamps, where, if used bare, only frosted lamps would be permissible. At the same time, enough light passes through the prisms to make a pleasing appearance and add to the advertising value of the lights. Where it is desired to hide the lights entirely, they should be placed just above the top of the glass of the window. The reflectors will then concentrate the light and direct it downward, allowing just sufficient illumination for the ceiling. The reflectors can be slanted so as to illuminate a window of any depth or height. In case they are not placed higher than the top glass, a black band should be painted on the glass of sufficient depth to hide the reflectors from observation from the street.

A novel effect may be obtained by forming any desired sign in the black band, the light shining through the reflectors, making the letters stand out distinctly.

FIG. 1. SIDE VIEW.

FIG. 2. SIDE VIEW.

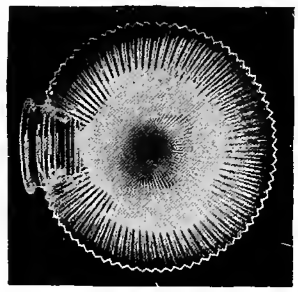


FIG 1. TOP VIEW.

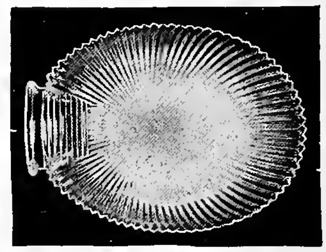


FIG. 2. TOP VIEW.

HOLOPHANE REFLECTORS FOR WINDOW LIGHTING.

In these days of strenuous competition, it is fast becoming evident that the most successful merchants are realizing that a window properly lighted is a strong selling factor that cannot be ignored.

Properly constructed reflectors are as essential to an enterprising merchant as a good advertisement in his local paper.

HYDRAULIC TURBINE AND GENERATOR AT NELSON, B. C.

A test run of an Allis-Chalmers Hydraulic Turbine Generator unit was recently conducted at the city power plant of Nelson, B. C. The turbine generator unit has a normal capacity of 750 kilowatts, but during the test run, this output was increased to 1,340 kilowatts for a period of over 45 minutes continuous running without undue increase in temperature of bearings. The usual tests were made as to the heating of the coils and bearings. According to the guarantee the armature and field coils did not rise in temperature above 35 degrees. The supply for light and power has been furnished up to the present time by the West Kootenay Power & Light Company, across the Kootenay River, from the new city power plant, out of which source both companies derive their power.

ELECTRICAL TRANSMISSION OF PHOTOGRAPHS.

The chief difficulty found in electrically transmitting photographic images has been the slowness of transmission and a want of distinctness, owing to the necessarily long exposure required by the fact that selenium loses more slowly than it acquires the conductivity due to the action of light. This has been partly overcome by employing a compensator consisting of two selenium cells, one of which receives directly the illumination of the photograph to be transmitted, while the other receives the light sent by a galvanometer intercalated in the electric circuit.

NEWS NOTES

TELEPHONES AND TELEGRAPHS.

Asotin, Wash.—The P. S. Telephone Company has commenced building a line to Vineland.

Tacoma, Wash.—Work has been commenced installing the telephone exchange in the court house.

Dexter, Ore.—The Dexter Tel. Co. has applied for a franchise to extend its lines from here to Springfield.

Oregon City, Ore.—The Clear Creek Mutual Telephone Company has purchased the Bonney line through Parkplace.

Marshfield, Ore.—The Pacific States Telephone Company will erect a new exchange building at corner of C and Second Streets.

Shell, Wyo.—The Shell Telephone Company, with a capital of $1,500, has been incorporated. A line will be built to Greybull.

Waitsburg, Wash.—The Pacific States Tel. Co. has leased the plant and system of the Waitsburg Rural Tel. Co. for a term of ten years.

Calgary, Alta.—The Council has voted in favor of installing a municipal telephone system. About 4,000 telephones will be required.

Spokane, Wash.—Contract has been awarded to Fife & Connor for $20,000 for blasting and stone work for ditches for the Home Tel. Co.

Portland, Ore.—Work has been commenced on improvements to the Pacific States Telephone & Telegraph Company, to cost $1,500,000.

Missoula, Mont.—The People's Telephone Company, capital $10,000, has been incorporated by F. M. Taylor, R. D. Prescott, J. A. Moss and W. R. Hamilton.

Tacoma, Wash.—The Home Tel. Co. will erect a one-story brick sub-station at once to cost $15,000, at South 45th and L Streets; plans by Russell & Babcock.

Livingston, Mont.—The Shields River Telephone Company is planning to construct branch lines from Clyde Park to Cottonwood and Horse Creek and establishing a toll line from Myersburg to this place.

Eureka, Cal.—Attorney L. F. Puter of this city states that he represents capitalists who will establish an independent telephone system here, with long distance connection to San Francisco, Redding and the East.

Eugene, Ore.—The Creswell and Cloverdale line, the Camas-Swale line and the Howe telephone line have been consolidated by L. A. Newton, of the Pacific Telephone Company, and will be connected with the Eugene system.

Farmington, Mont.—The Farmington Co-operative Telephone Company has been incorporated with a capital of $6,000 by H. R. Thompson, R. H. Wright and Ben Bolland. The company will build lines to Chateau, Collins and Conrad.

Clarence H. Mackay, president of the Postal Telegraph Company, has announced that his company will shortly commence the construction of a new route beginning at Salt Lake and ending at San Francisco. At a point midway, probably at Reno, a connecting line will be run south in the heart of Nevada, touching Goldfield, Tonopah, Manhattan, Rhyolite, Beatty and other towns to a point on the main line of the Santa Fe. The estimated cost is about $1,000,000, and the length of the line will be from 1000 to 1200 miles. President Mackay has been making a hurried trip of inspection of the Postal lines in California, Nevada and Utah.

San Francisco, Cal.—E. C. Bradley, assistant to the president of the Bell Telephone Company of Boston, whose stockholders are largely interested in the Pacific States Company, has arrived here from the East, and intends to stay for some time. It is known that he has come to the Coast to render what service he can to the local 'phone company during the progress of the graft investigation. He is familiar with conditions in San Francisco, as he planned the reconstruction of the local system after the fire of last April.

San Francisco, Cal.—The Southern Pacific Company is preparing to spend hundreds of thousands of dollars in the establishment of new copper-wire telegraph lines and the establishment of several supplementary galvanized-iron wire lines, all demanded by the greatly increasing volume of business and the growth of the country served by the railroad. A solid copper wire is to be strung from San Francisco to Ogden, supplementing the two already connecting those two points. Another solid-copper wire is to be stretched from here to Ashland, Ore., and there connected with the Oregon Shore Line, copper wire stretching on to Portland A new copper wire is to be strung from San Francisco to Los Angeles for local business, to relieve the immense strain now put upon the through copper wire from San Francisco to El Paso In addition to these expensive lines the company is about to string new galvanized iron wires from San Francisco to San Luis Obispo, from Sacramento to Red Bluff, and from Nogales to Guaymas, in Mexico. The copper wires are well adapted to "quad" service, with two operators working on each end at the same time, sending four messages over the one line simultaneously. In conjunction with this extensive improvement the Southern Pacific is installing a private telephone exchange in the Flood Building here, where seven operators will be kept busy. This, it is said, will be the largest private exchange in the West.

INCORPORATIONS.

Los Angeles, Cal.—The American Crude Oil Company has been incorporated here with a capital stock of $500,000. Those behind the enterprise are J. M. Danziger, W. F. West and D. C. Wallace.

San Bernardino, Cal.—Articles of incorporation have been filed by the Rialto Land and Water Company, which place the capital stock at $100,000. Those financing the company are A. A. Leighley and E. W. Lawrence of Los Angeles and G. H. Peters of Rialto.

Wonder, Nevada.—The Wonder Water Company, incorporated in California under the management of E. S. Cunningham, delivered water in the town of Wonder, May 1, 1907. The company has absolute water rights to Bench Creek springs, in the Alpine mountains, six and one-half miles from Wonder, and will deliver water to all parts of the town at two cents per gallon, eight cents less than the previous cost. W. A. Stevens of San Francisco is president and manager, W. A. Starr, vice-president and secretary, and J. T. Overbury of Rhyolite, A. P. Eisen of Goldfield and Roger Chickering of San Francisco the board of directors. Stevens, Chickering, Cunningham and Starr will run an ice plant in connection with the waterworks. Mr. Cunningham will have the supervision of the construction of the plant, on which work will be rushed as soon as the machinery can be delivered.

POWER AND LIGHT.

Waistburg, Wash.—Roberts & Henderson are planning to enlarge their electric light plant.

Moscow, Ida.—The Idaho-Washington Light & Power Co. has been incorporated with a capital of $500,000.

Battleford, Sask.—Bids will be received by O. C. Lourie, secretary, until May 10 for installing an electric lighting system.

Port Orchard, Wash.—The Port Orchard Electric Power Company, capital $100,000, has been incorporated by Adah M. Eubanks and Alfred S. Eubanks.

Basin, Wyo.—The Basin Electric Light & Power Co. is contemplating the installation of additional boiler of 85 horsepower. F. E. Frisby, manager.

Oroville, Wash.—Two carloads of machinery have arrived for the Oroville electric plant that is being erected on the Smilkamen, four miles above town.

Everett, Wash.—Eastern capitalists, represented by Emery, Romke & Denny, are planning to erect a large power plant near Sultan at a cost of $150,000.

Aberdeen, Wash.—The Grays Harbor Electric Railway and Lighting Company will erect a central power plant between here and Hoquiam at a cost of $300,000.

Grangeville, Ida.—The Big Baldy Mining and Milling Company will erect a large power plant on Crooked creek, power to be used in developing mines in Buffalo Hump district.

Baker City, Ore.—The People's Light and Power Company, capital $250,000, has been incorporated by Ray Nye of Fremont, Neb., and John Thomsen and Isador Fuchs of this place.

San Francisco, Cal.—The Board of Supervisors has passed an ordinance ordering the erection of 14 electric light arches at street crossings on Fillmore street, between Fulton and Sacramento.

Corona, Cal.—The City Trustees have signed a contract with the Corona Electric Company whereby ten arc lights of 2000 candlepower and 160 incandescents of 32 candlepower are to be furnished for $2500 a year.

Mountainhome, Ida.—The Mountainhome Electric Company will enlarge its plant at once, and has awarded contract to the Spangenberg Electric & Machine Company for a 75-kilowatt, three-phase, 60-cycle, 220-volt, rotating-field generator; also a modern marble switchboard.

Cordelia, Cal.—E. D. N. Lehe, the well-known electric light and power promoter of Dixon, who operates all the electric plants of the smaller towns in the Sacramento Valley section, has decided to run a line into Cordelia for the purpose of supplying lights and power here.

Yerrington, Nev.—F. J. Baum and R. F. Maynard came in from Carson City by way of Wellington the first of the week. They are looking over the field with a view to disposing of electric power from a plant which they expect soon to establish near the headwaters of the Carson River.

Wenatchee, Wash.—Electrical engineers in the employ of the Great Northern are preparing plans for replacing steam with electrical power in the Cascade tunnel. The plans include the construction of two power houses of 7,000 horsepower each at different points on the upper Wenatchee river.

Dixon, Cal.—E. D. N. Lehe and F. R. Orella have purchased the Rio Vista Electric Light and Power plant and are making arrangements to extend a power line from here to that town immediately. They will furnish light and power there for the whole twenty-four hours, double the time granted by the old company.

Seattle, Wash.—The City Lighting Company of Seattle has been granted a franchise for owning and operating a gas plant in West Seattle with the proviso that gas shall be charged for at a rate of $1.25 per thousand, with a rebate of 25 cents per thousand if bills are paid before the 10th of the month. The company has been given thirty days to consider acceptance.

Seattle, Wash.—The capacity of the city lighting plant is to be doubled and bids are being received for two 8,000 horsepower turbines; two 4,000 kilowatt, 2,300 volt, 60 cycle, three phase, revolving; nine 1,500 field alternating current generators; nine 1,500 kilowatt 2,300-3,500 volt transformers for the generating station and eight 5,400-2,500 volt transformers for the sub-station.

TRANSMISSION.

Napa, Cal.—In a special session held recently the Board of Supervisors granted a blanket permit to Henry Brown, the local banker, to construct power lines along the county roads in this county. Brown refuses to state for whom he is acting, otherwise than that he is to establish a competing power company.

Rhyolite, Nev.—The Rhyolite Heat, Power and Light Company has practically completed its power plant and the town is lighted by electricity for the first time. The plant is operated by large gasoline engines and is the only one in the State using this power. At first the company will not furnish power to the mines, but later on larger engines will be installed and many of the mines will use the electricity to run their hoisting works.

Forest, Cal.—An electric power plant is to be erected at the juncture of Wild Canyon and the North branch of Kanakab Creek, where 100 inches of water under 500 feet head and 50 inches of water with 300 feet fall may be had the year round. This power is to be utilized for the operation of air compressors for power drills, a forty-stamp quartz mill to which ore is to be trammed from the ledges, and electric lighting plant, power trams and sawmill plant. The work is to be done by an Eastern syndicate.

Oroville, Cal.—The problem of furnishing cement for the giant works of the Great Western Power Company at Island Bar has kept the engineers of that company busy for several months. The solution of the problem has been found in the old diggings of Cherokee. Sand from there has been tested and found to be of the grade necessary for the composition of the best Portland cement. Six months ago Veile, Cooper and Blackwell, consulting engineers for the Great Western Power Company, took time by the forelock and corralled all the loose cement they could find in California. They still require some 350,000 barrels and the sand for this can be obtained from Cherokee and hauled to Island Bar. It is planned to build an electric road between those places, a distance of six miles. Cherokee is having a livelier boom than ever since the old mining days.

WATERWORKS.

Redwood City, Cal.—The matter of purchasing a meter for the outlet from tanks and laying of pipe on Starabargh Street to the waterworks has been laid over until a later meeting of the Trustees.

San Jacinto, Cal.—At a special meeting held recently by the City Council a bid for the new pumping plant was accepted. Whether the old station will be repaired, a new plant erected on another site, or water obtained from another source, are questions to be answered at an early meeting of the Council.

Monrovia, Cal.—The City Trustees agreed last week upon electricity or gas as motive power, instead of steam, for the pumping plant to be installed at the city wells. The clerk was authorized to advertise the sale of $10,000 bonds for this purpose and $15,000 bonds for overhauling the present system of mains and making extensions.

Los Angeles, Cal.—The Long Beach Water Company is making extensive improvements in its wells north of Signal Hill by installing a complete electrical pumping apparatus. Eleven powerful motors will be put in at a cost of $10,000.

Alleghany, Cal.—Ground has been broken for a waterworks system which is to be installed and in operation by July 1st. The plant is being put in by H. J. Johnson, owner of the Tightmer Mine, but it is to be owned by the city. The plant will have a capacity of 23,000 gallons per day for domestic purposes.

San Francisco, Cal.—It has been decided that the city's auxiliary fire protection system shall be operated from the Twin Peaks reservoir, and that fresh water shall be used instead of salt water. The decision was reached on the recommendation of the Chief Engineer, who held that salt water disintegrated iron pipe in a few years. The fire stations on the bay will maintain and increase the pressure in case of big fires and the locations of the other stations have been settled. One will be at the foot of Twentieth street, near the Union Iron Works, one at the foot of Townsend street, and the third at the foot of Van Ness avenue. From these three stations a main skeleton of 20 and 18-inch mains will stretch over the streets, connecting at Market and Van Ness with the 18-inch mains from the hill reservoirs. On Twin Peaks, at 755 feet elevation, a 10,000,000-gallon reservoir will be built, which will be filled by pumping from wells in the Mission in the region of Howard and Twentieth streets. From this large reservoir two 18-inch mains will connect with a 600,000-gallon reservoir at an elevation of 440 feet, which will be in constant use, keeping the normal pressure on the mains. Practically all the streets in the heart of the city, will have mains running through them, as the network is to be very extensive. Permanent connections will be made for the two fireboats on the water front.

TRANSPORTATION.

Los Angeles Cal.—Following the request of the Pacific Electric Company for a permit for the construction of a viaduct across Los Angeles street south of Sixth, the City Council has asked the City Attorney if such action would be legal. The question is as to the need of a railway franchise to cover the project.

Salt Lake, Utah.—An agreement has been reached between the Electrical Workers' Union and the Utah Light and Railway Company. The corporation granted the men an increase of 77 cents a day for foremen and 50 cents a day for linemen. The men asked that the foremen be given $5 a day and the linemen $4.50. They had been receiving $4 and $3.75, respectively. Former Congressman B. H. Roberts acted as mediator between the men and their employer.

Oakland, Cal.—General Manager Calvin of the Southern Pacific has announced that the company will soon have the narrow gauge line to the Alameda mole in complete running order as an electric line, and that it is proposed to have a fast electric train service on that road. All of the equipment has been ordered and is being moved forward as rapidly as possible. During the summer a large force of men will be kept at work making the changes necessary for the conversion from steam to electric power. One of the features to be introduced will be a fast electric train service between Oakland and Alameda, with the Oakland terminus at Fourteenth and Franklin.

Monterey, Cal.—Every mile of the 150 miles of the right of way of the Monterey, Fresno and Eastern Railroad Company has been obtained and construction work has been commenced on the line, which is to unite the San Joaquin Valley with the Bay of Monterey. By October 1 the road will be in operation between here and Hollister, a distance of 60 miles. This run will be through a district rich in agricultural products. The route of the line is from Monterey to Salinas, to San Juan, to Hollister, to Tres Pinos, to Cleveland, to Fresno. The total cost of construction and equipment will be $2,500,000, and the estimated earnings computed from a study of the conditions, will be $1,027,041.56 a year, sufficient to pay operating expenses, 5 per cent interest on $3,000,000, a 6 per cent dividend on the preferred stock amounting to $90,000, and leave an annual surplus of $170,816.32.

Sacramento, Cal.—A great deal of work is being planned by the Sacramento Electric, Gas and Railway Company for the coming summer. The street car lines are to be greatly improved. Work on the T street line will commence as soon as the material arrives from the East. The trolley poles for the line have already been put in place. The company intends also to improve the track of J, G and P streets. On J street the asphalt is to be torn up for about a foot on the inside of the rails and replaced by hard brick to prevent the street being torn up by the heavy wagon traffic passing over the rails. On G street, from Seventh to Nineteenth, the rails are to be torn up and replaced by heavier ones. The track will be ballasted with crushed rock, so as to put it in condition for many years' service without further improvement. The company is also erecting a $20,000 reinforced concrete building on N street for storing cars.

San Francisco, Cal.—The members of the Carmen's Union are out on strike, having voted last Sunday morning to leave their work because no agreement could be reached with the United Railroads. As a result the street car traffic of San Francisco has been entirely stopped, and the efforts made thus far to run cars through the streets have utterly failed. Mobs have attacked the cars, which were loaded with armed men hired by President Calhoun, and driven them to seek safety in the car barns, where large aggregations of ruffians are kept under arms by the railroad company. Promiscuous shooting by the strikebreakers has resulted in one death and a score of wounded citizens. The members of the union have assisted the police to the extent of their power in keeping order, but threaten to stop such efforts unless the reckless shooting by the hirelings of the company is discontinued. Militia and United States troops will be called out to quell the disorder if the police, with special aids authorized by the Mayor, are unable to cope with it.

FINANCIAL.

San Francisco, Cal.—Richard Hotaling, W. M. Rank and their associates have made a deal with a Baltimore syndicate by which a big electric railroad system is to be built in Marin, Sonoma, Napa and Lake counties, with ferryboat connection with this city. The proposed system will invade the territory of the Northwestern Pacific in Marin and Sonoma counties and that of the Southern Pacific in Sonoma and Napa counties. The undertaking involves the expenditure of between $10,000,000 and $15,000,000, and will include the purchase of the Petaluma and Santa Rosa electric road. Hotaling, Rank and their associates already have a terminal on Richardson's Bay, just across from Sausalito, and they have made surveys from it to San Rafael, thence to Novato and Napa, and thence to Lakeport. The proposed road will embrace an extension of the Petaluma line northward into the Healdsburg and Cloverdale country. Ultimately it will be extended into Lake County, thus forming a double line covering a great sweep of country between Lake and the Marin bay shore.

San Francisco, Cal.—A meeting of the committee appointed to represent the commercial and improvement organizations of the city was held and the question gone over thoroughly. Captain Payson was present and made a talk on the situation, telling of the difficulties which had met the Spring Valley Company in its efforts to supply San Francisco with water. He hinted that the grafters had made it hard for the company for refusing to come to terms. On being asked the terms on which the corporation would sell out to the city after ten years, according to the plan of the committee, he agreed to consult the directors and make a reply at the earliest possible moment.

San Francisco, Cal.—At a recent meeting of the Board of Supervisors a petition was presented from the City Real Estate Board asking that the resolution recently adopted revoking the franchise of the Spring Valley Water Company and declaring its properties escheated to the city be rescinded in order that the company might have a chance to rehabilitate its plant. The question was referred to the Public Utilities Committee.

San Francisco, Cal.—It is asserted by the local papers that a syndicate of New York and San Francisco capitalists will within the next few weeks make an application to the Board of Supervisors of San Francisco for a franchise for a system of electric street railways as a rival to the United Railroads. In the syndicate are Leopold Michels, the Myersteins and the Brandensteins of San Francisco and a coterie of New York millionaires represented by Leopold Wallach. The enterprise is being financed through the Knickerbocker Trust Company of New York and many millions of capital are represented. Agents of New York interests have been in San Francisco for several weeks and have completed a study of the streets and the engineering problems to be met in the proposed new system. Maps have been drawn and every detail arranged. The syndicate lacks only the franchise to make its plans complete. It is said that the plan includes a network of lines covering the whole city, and that part of the system will be run by overhead trolley and part by conduits. The scheme had been proposed before the fire, then temporarily abandoned, and again resumed on the report of the great traffic in this city which the United Railroads are unable to handle.

CLASSIFIED LIST OF ADVERTISERS

ELECTRIC RAILWAYS.

Portland, Ore.—It is reported that the Oregon Electric Company's line to Salem will be completed in four months. The line will be forty-nine miles in length.

Walla Walla, Wash.—The Walla Walla Valley Traction Company will at once commence work on its passenger and freight depot for Milton and Freewater, one building to serve two cities.

Baker City, Ore.—Council granted a thirty-year franchise to William Pollman and associates to construct and operate an electric street railway; also to run an urban line to Rock Creek and Haines.

Snohomish, Wash.—The Snohomish Construction Company, Edward Wright, president, has been organized to construct the Snohomish Valley Railroad, the proposed electric line from this place to Seattle and Tacoma. Work will be commenced at once.

Riverside, Cal.—Formal application has been made by the Crescent City Railroad Company to the City Trustees for a franchise for the proposed trolley line that is to connect Riverside with the new cement plant now being built at Western Riverside by the Southern California Cement Co. An ordinance has passed its first reading, advertising the sale of the franchise.

Parral, Mex.—This place is to have an electric street car system in the near future. Bids for the building of a portion of the line are ordered, and $150,000, the amount of the company's present capitalization, has been fully subscribed and paid up. The name of the organization is the Compania de Ferrocarril Urbano de Parral. Juan Baustista Baca is the president.

Salt Lake City, Utah.—The street car situation here has reached an acute stage. There have been several days of negotiations between the Utah Light and Railway Company, a Harrison corporation, and its employees. The company declares that its earnings are not great enough to permit the payment of the wage scale demanded by the men—twenty-five cents per hour for first-year men and thirty cents per hour after the first year. This is fifteen per cent more than the men are now getting.

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ILLUMINATION.

Guadalajara, Mex.—J. Guillermo Dominguez, a Mexican attorney of Los Angeles, has secured from the Government of Jalisco a concession for a gas plant in Guadalajara.

Club has taken up the matter of lighting that thoroughfare from Montgomery to Market and equipping each block with two modern electric light posts, each with a cluster of four burners. The Board of Supervisors has been petitioned to assist in the work.

Berkeley, Cal.—Representatives of the conference committee of the improvement clubs of Berkeley have invited the American River Electric Company to bid for a franchise to operate a lighting plant in Berkeley. Mortimor Fleishaker of San Francisco is one of the backers of the company.

San Francisco, Cal.—The Dolores Street Improvement Club at a recent meeting resolved to help the city in the matter of lighting Dolores and Sixteenth streets. The members pledged themselves to defray the expenses of installing electric lights from Market street to Twentieth along Dolores and from Guerrero to Church along Sixteenth street. The cost will approximate $1200. On the first call for subscriptions $700 was subscribed.

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The JOURNAL OF ELECTRICITY

POWER AND GAS

WITH WHICH IS INCORPORATED

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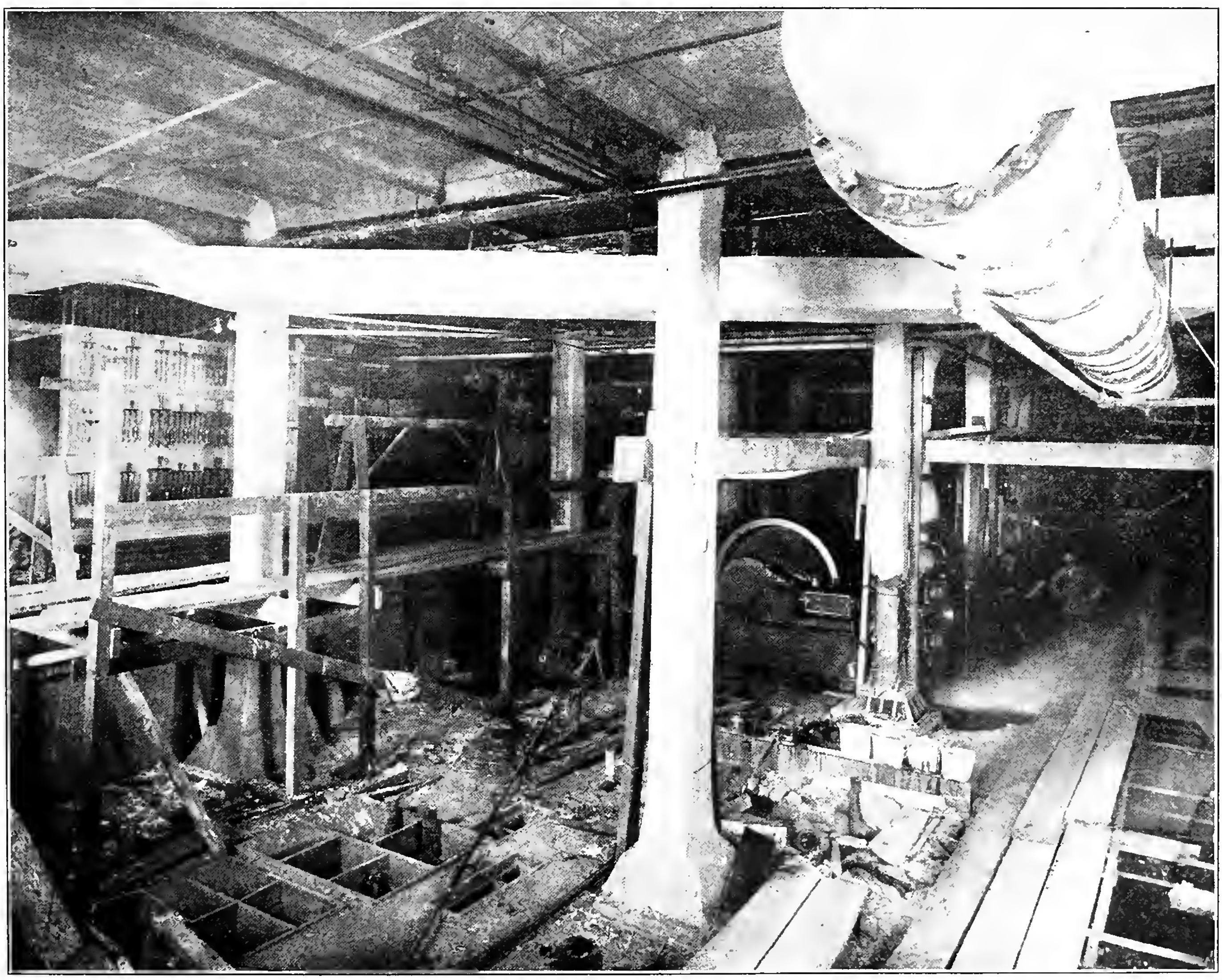
VOLUME XVIII. SAN FRANCISCO, CAL., MAY 18, 1907 No. 20

ELECTRIC INSTALLATION OF THE HOTEL FAIRMONT

Wishing to be independent of any possible break-down in the power plants supplying current for San Francisco's use, the Fairmont Hotel management has installed a generating plant capable of supplying all the lights and motors in the building. As shown in the accompanying illustration, this plant is but half completed, and until the installation is finished considerable current will be taken from the wires of the California Gas & Electric Corporation.



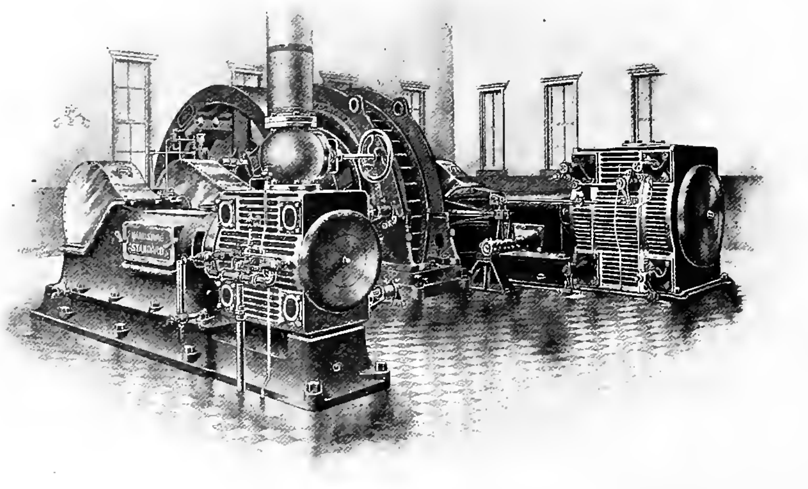
GENERATING PLANT OF THE HOTEL FAIRMONT

The dynamos are two in number, both being direct-current, three-wire Westinghouse design, one generating 75 kilowatts, the other 150 kilowatts. The former is direct connected to a 11x16x12 tandem compound Ideal engine, running at 275 revolutions per minute. The latter is likewise direct connected to a 17x16x12 Fleming four-valve engine, running at 215 revolutions per minute. The engines were furnished by Chas. C. Moore & Co., Engineers, of San Francisco. Similar engines are to be placed in the pits shown in the picture. Here, as throughout the rest of the plant, all machinery is firmly mounted on concrete foundations.

The 3-wire system saves considerable copper, giving economy in distribution. The 220-volt motors are supplied from the smaller machine, while the lamps are supplied from the 300-ampere generator. Both furnish current at 250 volts. By this system 110-volt lamps and motors may be symmetrically connected approximately half and half between the neutral and each outside lead, 220-volt constant speed motors across the outside lines, 220-volt variable speed motors across the outside lines, and their low voltage con-

nections divided between the two sides of the system. But a small proportion of the current is delivered over the neutral wire and the greater part of the total energy is transmitted at the higher potential. Westinghouse 3-wire or double voltage machines differ from standard single voltage, direct current machines only in that additional leads from the armature winding are connected to collector rings mounted on the armature shaft.

Steam is to be furnished from six Parker boilers, furnished by the Keystone Boiler Works, of San Francisco. The present boiler set comprises two Parker and two Franklin boilers. The restriction in vertical height required that the lower fire boxes of the boilers be cut off, and also necessitated using horizontal tube boilers in order to get the requisite 2,000 square feet of heating surface. Chief Engineer Leavitt introduced an oil-burning system of his own planning, designed especially for long fires in low settings. All pipes and radiating surfaces are covered with magnesia blocks.



FLEMING FOUR VALVE CORLISS ENGINE

The building is piped throughout for both lighting and telephone service with iron armor conduit. Each room has its own telephone connection through the main office, and this branch of the work is noteworthy from the fact of its being the largest private exchange on the Coast, over 1200 drops being controlled, and operated from the main office board.

The lights in the various rooms are individually controlled from flush switches and each floor from the second up to the seventh has four centers of distribution, equipped with tablet boards with separate control for each circuit ramifying therefrom.

These boards are three-wire front-connected tablets, with two-wire distribution, the bus-bars being mounted on the face of the tablet, and all switches being protected with National Code Standard cartridge fuses.

All metal work is highly polished, and mounted on marbleized slate, with lining, and a wiring compartment of three inches is provided all around to permit of easy access, and arrangement in connecting up, as well as in the event of any trouble. The outside compartment is a metal box into which all circuits are brought with iron armor conduit, the finish being separate and of the same material as the surrounding woodwork, held in place by four screws, making it possible to quickly and easily gain access to the wiring compartment in case of necessity. The appearance of these boards as a whole presents an extremely pretty effect, especially so the one located in the main lobby. This board is made of white Italian marble with highly polished face, and has 88 D. P. panel switches with fuses, and is arranged as a double panel, having two sets of bus bars, all highly polished and mounted on the face of the board.

Each distribution center has a separate set of feeds which run direct to the main board located in the engine room.

The fixtures in the various public rooms are the finest ever seen on the Coast, and various effects, produced with due regard to the surroundings, are in such perfect harmony as to excite the admiration of any lover of art. The effects in vines and trellises as well as other emblematic objects, are entirely original, and are the design of Mr. G. A. Shastey, the supervising agent.

The main controlling panels are located in the engine room, and comprise a continuous board 32 feet 8 inches long.

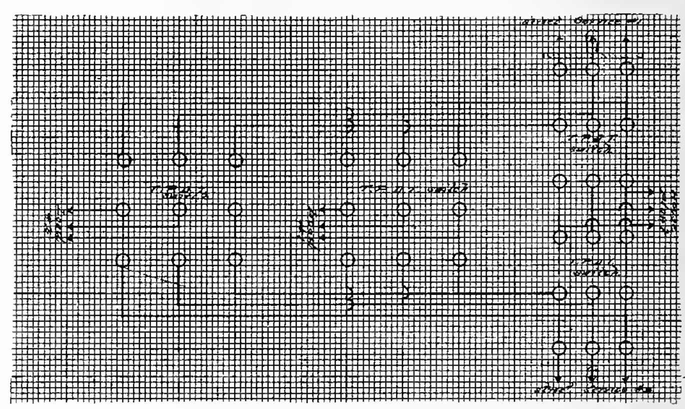
These panels are of two-inch blue Vermont marble, 70 inches high, and the arrangement of the various controlling switches is made with the object of convenience and system, and it is almost impossible to cause trouble, the board being practically fool proof.

The first four panels to the left control all the lighting feeds and comprise thirty-one 100-ampere, two 200-ampere, two 300-ampere triple pole National Code fused switches. The lighting load is split into halves, and a double set of three-wire bus bars feed these panels.

Next to these panels is the break down panel. This has four 1,500-ampere ammeters, at the top, so connected that the load on either set of bars is always indicated.

There are two 1,500 ampere T. H. triple pole double throw and two 1,000 ampere triple pole double throw switches for the main lighting control.

The following cut shows the connections of these switches. Following the lighting breakdown panel, come the four generator panels for the control of one 75-kilowatt, two 150-kilowatt, and one 200-kilowatt three-wire Westinghouse generators.



WIRING CONNECTION

These are arranged to run in multiple on either power or light bars, so it is possible to run only one machine on power and the balance on lights, or in fact, any combination desired.

Following this comes the power breakdown panel for the control of all power circuits. A 1,000-ampere ammeter registers this load at all times, irrespective of whether service is from house plant or city.

One 1,000-ampere D. P. D. T. and one 500-ampere D. P. D. T. connected to various services, allow either the power side plant or light side of the house plant, or the street

service to furnish the power bars. A recording wattmeter is connected direct to power busses.

The last panel is the power controlling panel, and comprises eight 75 amperes and four 200 amperes D. P. S. T. National Code fused switches.

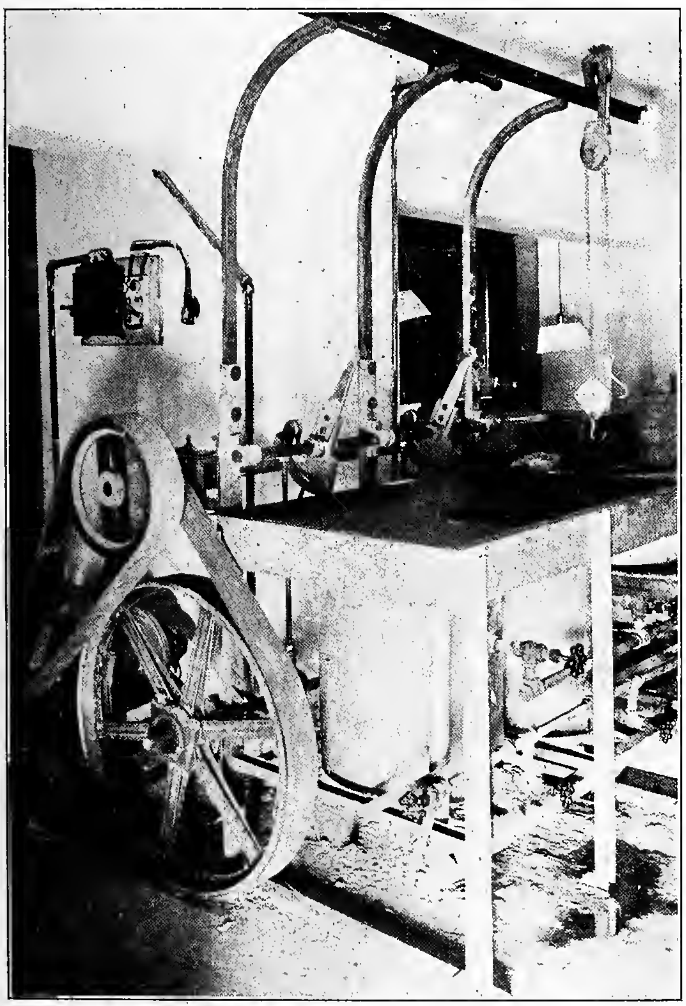
All switches on the board are hand finished, of German scroll design, and all screws and nuts are highly polished, and gold lacquered.

It might be mentioned in connection herewith that the entire installation of switch and panel boards, comprising a total of 1012 circuits, and the main board, was not let until the 12th day of March, and that the building was lit and ready on the 16th day of April.

This work, comprising as it does the largest job of its kind ever done in this city, was carried to a successful completion by the Drendell Electrical and Manufacturing Co., all of the material for the same having come from their own stock, this being proof of the fact that this company is in a position to handle practically any installation regardless of the magnitude or conditions to be met.

The source of supply from the street service for the lighting is furnished by a two-phase high tension primary line of 2,200 volts.

This is connected as a single phase three-wire secondary system, so arranged that either bank of transformers can, in case of emergency, supply the entire lighting load of the building, as will be noted by connections as shown on the lighting breakdown panel, cut of which is shown above.



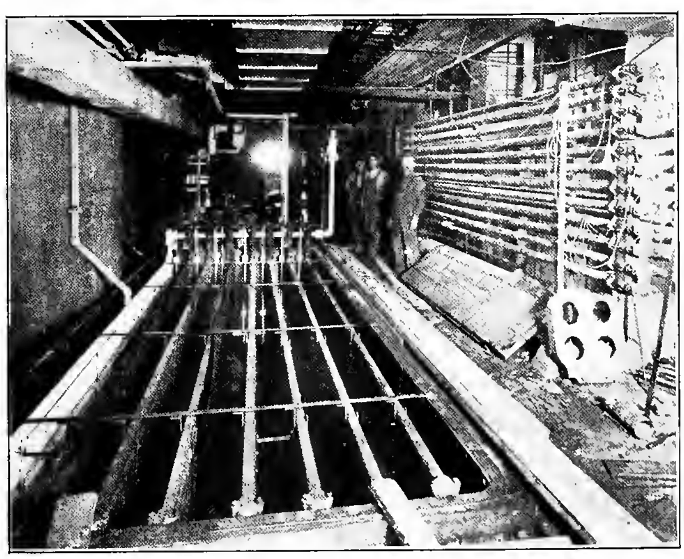
DISH WASHING MACHINE

The probabilities of any contingencies arising that would necessitate a complete shut down, under this system of control, are so remote that it seems almost an impossibility.

The completion of the work now in progress is under the direction of Mr. L. R. Boynton, formerly superintendent of construction for the Hendy Electric Co.

The various applications of electric current throughout the hotel are not only interesting but also illustrative of the importance of the electric motor in the domestic economy of to-day. Thus, in the kitchen all dish washing is automatically done by two New Century dish-washing machines belted to motors. The accompanying picture shows the device for washing the knives, forks and spoons. The copper pot with perforated bottom is filled with the silverware, and, by means of a chain block, is raised from the table and lowered into a larger pan filled with suds, being supported by an arm which imparts a vertical motion to the cylinder by means of shaft and eccentrics. Steam is used for heating. The crockery machine consists of three cylinders. An electric motor is used to run the ice-cream freezers. As originally planned, the equipment of the kitchen was to include various electric cooking devices. But, as the Palace Hotel management brought a large steam-cooking plant from their temporary "Little Palace," the matter of installing the electric devices has been postponed.

The laundry equipment is all electric driven. It is in two sections; one for the plain, unstarched goods of the hotel, the other for the guests' clothes. The latter has not been completed yet. The soiled clothes are placed in three cylindrical rotary washers driven by a 7½-horsepower motor, which is capable of driving three more washers, yet to be installed. The two extractors are each direct-connected to 3-horsepower motors. The water is removed from the clothes by the centrifugal force derived from 1,000 revolutions per minute. From these the clothes are taken to a rotary loosener which prepares them for the mangle. This is direct connected to a 3-horsepower motor that gives from fifteen to twenty per cent. efficiency over and above a steam-driven machine. The latest designs of drying and ironing devices have been installed. Drying is to be done by a Bonds & Erbe conveyor dry room, capable of drying shirts, collars, cuffs and starched articles in twenty-five minutes. All ironing is to be done by machines, working automatically and independent of skilled operators. All machines are to be run by a 10-horsepower motor. The laundry equipment was put in by the Western Laundry Co., of San Francisco.



REFRIGERATOR PLANT

The refrigerating and ice-making plant is very complete and covers a large field in its duties. The accompanying view shows it in course of construction. The system used is known as the ammonia compression system, using brine as a circulating medium. The brine is cooled in a large steel tank by the evaporation of ammonia in coils submerged in the brine. The ammonia gas from the evaporation is exhausted from the coils by a double-acting, horizontal,

ammonia compressor. This compresses the gas to the liquifying pressure and forces it into a double pipe condenser, where it is condensed or liquified and is ready to be used in the evaporating or expansion coils again. The process is continuous and little or no waste of ammonia is caused.

Ammonia storage tank, the oil separator, and the scale traps with their attendant connections go to make up the complete ammonia system.

The compressor is rated at a 25-ton refrigerating capacity, which means that it will perform the work equal to the melting of twenty-five tons of ice every twenty-four hours. The compressor is driven by a Corliss steam engine directly connected to crank shaft.

The brine cooled as before mentioned is used for the twofold purpose of circulating through coils placed in the various cold storage rooms and boxes situated in convenient localities in the culinary and storeroom departments, and also for freezing ice.

There are over twenty different cold-storage rooms or boxes. Each room is provided with separate circulation and regulation. These include the general supply or storage rooms in which the supply of the various perishable materials are kept, and also the supply of wines and beers. The service boxes, from which the materials are delivered, as called for by the patrons, are placed throughout the various departments of the kitchen in which the food is prepared. Consequently the food passes directly from cold storage to the fire or to the dining room, as the case may be.

Great care has been taken with the insulation of the cold-storage rooms, the walls, floors and ceilings being constructed with air spaces and four inches of sheet cork. No wood is used for the interior construction, the walls being plastered with special waterproof plaster. Galvanized iron is used for shelving. This makes a germ-proof and thoroughly clean and sweet room.

The brine mains leading to and from the various rooms contain about 1000 feet of pipe, and are insulated against heat by sectional cork coverings two inches thick.

Five tons of distilled water ice can be frozen daily in the brine tank, which has been placed in the machinery room. The ice is frozen in 100-lb. cakes for convenience in handling and is stored for distribution in a refrigerated room adjoining the ice tank. Electric-driven power machinery has been installed for cutting ice into cubes for drinking water, and shaving and crushing ice for various purposes.

To insure the purity of the ice an elaborate distilling and purifying apparatus has been put in, which works as follows: Exhaust steam is automatically supplied from the engine as needed and is run through an oil separator or filter, thence to a steam condenser of the marine surface type, and from there the condensed water runs to the reboiler, where it is thoroughly boiled and a portion allowed to skim or overflow. The reboiler removes air and other gases. From there the water is pumped through a water cooler, in which the hot water is cooled to the normal temperature by a circulation of cold water. From the water cooler the water passes through a charcoal filter which acodenizers and cleans it. From the filter it passes to a storage tank in which is placed an ammonia cooling coil. This coil cools the water to thirty-five or forty degrees, and it is ready to be filled into the cans. On its way to the cans it passes through a final sponge filter. The filling of cans is automatically regulated and a traveling crane is provided for raising the cans from the freezing tank.

The plant was furnished and installed by the Vulcan Iron Works of this city under the direction of Mr. J. T. Ludlow.

The heating and ventilating plant is electric-driven, and is so arranged with force and exhaust fans as to be controlled entirely by one man. The private dining rooms, basement, mezzanine, dining hall and ballroom are supplied by a steel-blade blower from the American Blower Co., of Detroit, Mich., and, like all the other blowers, is direct connected to an electric motor. Other fans were supplied by Wm. Bayley & Sons, of Milwaukee. All fans are encased in sheet iron, originally furnished by the Globe Sheet Metal Works, of San Francisco. During cold weather the air will be heated before being sent to the various parts of the hotel. All fumes are drawn from the kitchens and laundries by exhaust fans.

STARTING A MOTOR.

Before attempting to start a motor for the first time, test out the field circuit to see that it is closed. This may be accomplished as follows: Remove the wire at the starting box from the terminal marked "Arm," and carefully insulate the end. Then close the main switch and bring the starting lever up to the running position, and note whether the release magnet holds the lever in position. This shows whether or not the circuit is complete, since the magnet is in series with the field. Leaving the starting box in the above position, go to the motor and, with pliers or a piece of iron, note whether the poles give a magnetic pull. In performing this operation be very careful not to touch the field terminal, thus grounding or short-circuiting the field. As a final or third test, slowly open the main switch, and if an arc results the field circuit is complete. These tests should always be made before attempting to start up a motor for the first time.

When these tests have been completed, see that the main switch is open and the starting lever at the off position, thus opening the circuit; then replace the armature lead in its terminal on the starting box.

To start the motor, close the main switch first, and then slowly bring up the starting lever, until the motor is running at full speed. See that the armature oscillates in its bearings, and that all oil rings are turning and carrying oil. If the speed is excessive it will probably be found that in shunt machines a field coil is wrongly connected, while in compound machines it may be that the series is opposing the shunt. In the latter case, by reversing the series leads the trouble will be remedied, but generally it will be best to secure a competent man to check over the connections.

A series motor should be started up with load, never without load; if started without load it will race.

See that the starting resistance is in series with the armature; on starting cut it out gradually.—Allis-Chalmers Instruction Book.

METHODS OF WATER PURIFICATION.

For the removal of solids in suspension, gravity or mechanical filtration is generally employed and the present tendency is toward the increased use of those mechanical filters that combine the maximum of filtering area with the minimum of floor space required. These conditions are found ideally represented in the filter press, which, when used for water, has a large capacity.

Waters containing salts in solution can often be partially purified by boiling, but this is much more costly than the precipitation of the salts with chemical reagents. If, however, chemical materials alone are employed, they must either be used simultaneously with other processes or sufficient time allowed for the subsidence of the flocculent matter precipitated by the treatment.

Either of these methods has its disadvantages, and in consequence an apparatus is generally used which will both assist the chemical reaction required and also remove the impurities thrown out of solution.

These apparatus, which are of various designs, are called water softeners, and are the only true solution for the difficulties arising from the use of bad water.

THE USE OF ALUMINUM AS AN ELECTRICAL CONDUCTOR.

By H. W. Buck.

About the year 1898, the price of aluminum had been so reduced by the commercial application of the Hall process, that this metal began to come into prominence as a competitor of copper for use as an electrical conductor. In physical characteristics, aluminum differs materially from copper. Its properties give it some advantages, and some disadvantages. Some of its physical constants as it is now manufactured commercially for electrical purposes are as follows: Melting point, 1157 degrees Fahr.; elastic limit, 14,000 pounds per square inch; ultimate strength, 26,000 pounds per square inch; modulus of elasticity, 9,000,000; electrical conductivity, 62 per cent.; specific gravity, 2.68; co-efficient of linear expansion, .000,012,8.

On account of its properties, aluminum is not applicable to all the purposes for which copper is used electrically. At present its electrical utility is confined to (a) bus-bars, (b) high-tension overhead uninsulated conductors, (c) low-voltage feeders, usually insulated with weatherproof braid only.

Aluminum is barred from use in a number of cases on account of the practical impossibility of applying the ordinary methods of soldering. Its surface seems to have a coating of oxide on it at all times, which prevents the adhesion of the soldering metal.

At the present relative cost of the two metals, aluminum is about ten per cent. or fifteen per cent. cheaper than copper of the same resistance. The weight of a unit length of aluminum wire is only forty-seven per cent. of a copper wire of the same length and resistance. Consequently

aluminum can cost $\frac{1.0}{0.47} = 2.13$ times as much as copper per pound and still cost the same as copper per unit length from the standpoint of electrical resistance. As a matter of fact, however, the price of aluminum at present is less than 2.13 times that of copper per pound, so that it is actually cheaper to use aluminum as an electrical conductor than copper, where other considerations do not enter.

Use for Insulated Cable.

For all forms of wire and cable which have to be insulated with expensive materials, such as rubber, aluminum is at a decided disadvantage. Its lower conductivity necessitates a greater diameter than a copper conductor of the same resistance, and the extra cost of insulation required to cover the aluminum prevents it from competing with copper for this particular purpose on the basis of the present relative costs of the two metals.

Interior Wiring.

The difficulty in soldering aluminum wire conveniently, and the greater cost of covering it with insulation, renders its use for interior wiring practically out of the question.

Telephone Wires.

The high co-efficient of expansion of aluminum wire, and its comparatively low tensile strength, causes a greater sag at high temperatures than with copper in overhead line work. In telephone construction, where the wires, by necessity, are strung close together on the crossarms, this greater sag of aluminum would probably result in contact between wires at the deflections which would occur at summer temperatures. For this reason, together with the soldering difficulty, where lateral connections are made, aluminum is practically shut out of competition with copper for this particular use. There is also some objection to the use of aluminum wire as small as that required for telephone purposes, on account of the necessity of stranding it. There is no reason, however, why aluminum should not be used as a conductor for isolated aerial telephone lines, if a large enough wire can be used. In cases known to the writer where it has been used for such telephone circuits, it seems to have operated as a particularly good carrier of the voice. This may possibly be due to the particular balance which exists in an aluminum wire between resistance, inductance and capacity, aluminum having somewhat less self-induction, and more capacity, than a copper wire of the same resistance.

Bus-Bars.

Aluminum is particularly well suited for bus-bar constructions. Here no insulation is usually required over the bus-bar metal, while the great saving in weight, and the lower cost, are decided advantages in favor of aluminum. Care should be taken, however, in using aluminum for such purposes, to provide for expansion and contraction with changes in temperature, which is greater in aluminum than in copper. The increased section of an aluminum bar over a copper bar of the same resistance, affords greater radiating surface and allows a given current to be carried with a lower rise in temperature. Consequently, for a given temperature rise, which is usually the limitation in a bus-bar installation, and not "drop," an aluminum bar will weigh only about 38 per cent. of a copper bar for the same heating. This is an obvious advantage for aluminum. Such bars are being used extensively for carrying currents of very large volume, such as are required in low-voltage electrolytic plants.

Low-Voltage Feeders.

A very wide application of aluminum has developed for low-voltage direct-current feeders, especially for railway work. Sizes up to 2,000,000 cm. are in use for railway feeders, the cables being usually covered with weatherproof braid. Aluminum has many especial advantages for this purpose. The quality of the poles and crossarms frequently installed for the support of railway feeders is not of the best, and the 53 per cent. reduction in weight in the use of aluminum saves in maintenance and in line break-downs. The cost again enters as a 10 per cent. or 15 per cent. advantage. Furthermore, the increased radiating surface of the aluminum feeder allows a greater overload to be carried by it than with copper, without melting out the compound of the weatherproof braid, which happens so frequently in copper feeders from overheating, when cars become bunched on the line.

High-Voltage Overhead Lines.

The most prominent use of aluminum, electrically, and the one over which there has been the greatest amount of discussion, is that for overhead high-voltage transmission circuits. When aluminum was first introduced for overhead conductors, it was furnished in the solid form. Considerable trouble was experienced with this kind of wire from breakage resulting from flaws in the metal, and from "crystallizing" of the wire from swaying in the wind. About the year 1900, the stranded form was substituted for even the smallest sizes (No. 4 B. & S.), and the original trouble from breakage has been entirely eliminated.

The writer has communicated with most of the principal users of aluminum wire in this country, in order to establish, by the expression of opinion of prominent engineers, the position of aluminum as an overhead conductor in comparison with copper. The replies to these inquiries have brought out the following points:

1. That the experimental stage in the manufacture of aluminum wire has passed, and that the product, as now furnished by its manufacturers, is entirely reliable, and up to the guarantees made for it.

2. That there is no appreciable disintegration of aluminum wire from ordinary atmospheric conditions. Certain special cases have been reported of corrosion, all of them

affecting short lengths of wire only. One where wires were subjected to chemical fumes from factories, and others where the wire was exposed continuously to salt fog on the Pacific coast. It is probable that any metal would have been affected by this action. Under usual conditions, however, even on the sea-coast, aluminum is a durable metal. Weather-proof insulation serves as an effective protection against corrosive influences, when not accompanied by continuous moisture which will keep the weather-proof braid saturated. The Niagara Falls Power Company has successfully protected its aluminum line with weather-proof braid where it passes through the chemical factory district. On the sea-coast, where the atmosphere is damp, aluminum should not have weather-proof covering, for the above reason. The metal will protect itself by thin impervious coating of oxide, which is better than any artificial covering.

3. That no trouble is being experienced with the stranded aluminum wire in breaking from flaws, "crystallizing," etc.

4. That aluminum wire gathers much less sleet than copper. This is perhaps due to the grease which is absorbed in the aluminum due to its porous qualities, in the process of wire drawing or from some other physical condition of its surface.

5. That it costs less to string aluminum wire on account of its lighter weight.

6. That care must be taken in stringing aluminum wire in rough country on account of its softness; stones or rough places on the ground causing considerable abrasion, where the wire is dragged along the ground.

7. That the mechanical and splice joints as now used on aluminum wire are entirely satisfactory without the use of solder.

8. Care should be taken in the design of an aluminum pole line to place the wires as far apart as possible, in order to avoid trouble from burning off of the wire in case of a short circuit. The melting point of aluminum is much lower than that of copper, and the damage from a prolonged arc is therefore greater. If the wires are placed sufficiently far apart, any arc which may be formed will be so unstable that it will travel rapidly with the wind, or by magnetic repulsion, and will not stay long enough in any one spot to cause any appreciable burning.

The fundamental consideration which enters into the use of aluminum for overhead line work is that of wind pressure, and especially so in modern long-span construction problems. Aluminum is at a disadvantage compared with copper in this matter of deflection where long spans are considered. For example, supports for 400-foot spans of aluminum of 265,000 cm. section will have to be 3.4 feet higher than the supports for equivalent copper. For spans of 300 feet or less the matter of deflection is unimportant, for it makes little difference whether the deflection is two feet or three feet, more or less. But in very long spans where the difference may be 20 feet in the case of copper and 30 feet in aluminum, the question of deflection is of considerable moment, and the advantages are in favor of copper. The height, therefore, of a support for a long-span line of aluminum would have to be greater than for a copper line. Its strength, however, need not be so great as would be required for the support of a copper span. The weight of the aluminum wire is only 47 per cent of the copper span of the same resistance, and, furthermore, the tension in the aluminum cables will be from one-half to one-third those of the copper ones, depending upon the temperature. Where there are bends in a line, and when each pole is designed to withstand unbalanced strains due to the breaking of one or more wires, the lesser weight and tension on the aluminum cables is a decided advantage which offsets, in a measure, the increased height required for the aluminum supports.

No account of the extra weight, due to the formation of sleet on the wire, is taken in the calculations in this paper, for it does not seem to be the experience of most engineers that sleet forms on high-voltage wires. This is, perhaps,

TABLE I.—Dimensions and Resistances of Aluminum Cable. Resistance at 75 Degrees F. Resistance per Mil-Foot, 62 Per Cent Conductivity=16.949 Ohms.

SIZE.	Diameter stranded inches.	Area square inch.	Pounds per 1000 feet feet	Pounds per mile.	Feet per pound.	Ohms per 1000 feet.	Ohms per mile.	Elastic limit, pounds.	Ultimate strength, pounds.
1,000,000 CM	1.15	.7870	920	4,858	1.087	.01695	.08950	10,995	20,420
950,000 CM	1.12	.7470	874	4,617	1.144	.01784	.09420	10,440	19,400
900,000 CM	1.09	.7075	828	4,374	1.208	.01883	.09942	9,900	18,380
850,000 CM	1.06	.6680	782	4,131	1.279	.01994	.10529	9,350	17,360
800,000 CM	1.03	.6290	736	3,888	1.359	.02119	.11188	8,800	16,340
750,000 CM	1.00	.5890	690	3,645	1.449	.02260	.11933	8,230	15,320
700,000 CM	.96	.5500	644	3,402	1.553	.02421	.12782	7,700	14,300
650,000 CM	.93	.5120	598	3,159	1.672	.02608	.13770	7,150	13,270
600,000 CM	.89	.4720	552	2,916	1.812	.02825	.14917	6,600	12,250
550,000 CM	.85	.4330	506	2,673	1.977	.03082	.16275	6,050	11,230
500,000 CM	.81	.3930	460	2,430	2.041	.03300	.17900	5,500	10,210
450,000 CM	.77	.3540	414	2,187	2.415	.03766	.19884	4,950	9,190
400,000 CM	.73	.3141	368	1,944	2.718	.04237	.22370	4,400	8,170
350,000 CM	.68	.2750	322	1,701	3.106	.04843	.25570	3,850	7,150
300,000 CM	.63	.2360	276	1,458	3.623	.05652	.29830	3,300	6,130
250,000 CM	.58	.1965	230	1,215	4.348	.06780	.35800	2,750	5,110
0000 B & S	.54	.1661	194.7	1,028	5.733	.08010	.42290	2,330	4,320
000 B & S	.47	.1317	154.4	816	6.477	.10100	.53315	1,850	3,430
00 B & S	.42	.1045	122.[illegible]	647	8.165	.12740	.67270	1,460	2,720
0 B & S	.37	.0829	97.1	513	10.300	.16050	.84740	960	2,150
1 B & S	.33	.0657	77.0	407	12.990	.20250	1.0692	920	1,710
2 B & S	.30	.0521	61.0	323	16.400	.25540	1.3486	730	1,355
3 B & S	.26	.0413	48.5	256	20.620	.32200	1.7002	579	1,075
4 B & S	.23	.0327	38.5	203	25.970	.40600	2.1438	450	852

Elastic limit=14,000 lbs. per square inch.

Ultimate strength=26,000 lbs. per square inch.

due to the electro-static repulsion of the particles of water from the wires, which prevents their forming into sleet, or else a sufficient rise in temperature exists in the wire due to current to prevent freezing. Sleet would certainly not stay on a wire during a high wind.

Table I gives the resistance and other properties of pure aluminum cable as now manufactured in sizes from No. 4 B. & S. up to 1,000,000 CM.

being stretched so that it reaches its elastic limit at minimum temperature with the wind blowing at 65 miles per hour actual velocity. The other constants are taken the same as in curves 2, 3, 4 and 5.

Table IV shows deflections at various temperatures and span lengths without wind for No. 2 B. & S. aluminum, the wire being stretched to its elastic limit at minimum temperature, with the wind blowing 65 miles per hour actual

TABLE II.—Dimensions and Resistances of Aluminum Stranded Cables Equivalent in Resistances to Standard Sizes Copper. Resistance at 75 Degree F. Resistance per Mil-Foot, 62 Conductivity at 75 Degrees F.=16.949 Ohms.

SIZE COPPER.	Aluminum equivalent. Circular mils.	Diameter. Aluminum. Stranded inches.	Area. Aluminum. Square inches.	Ohms per 1000 feet. Aluminum.	Ohms per mile. Aluminum.	Pounds per 1000 feet. Aluminum.	Pounds per mile. Aluminum.	Feet per pound. Aluminum.	Elastic limit. Aluminum.	Ultimate strength. Aluminum.
1,000,000 CM	1,580,700	1.45	1.2415	.01072	.05660	1454	7678	.6878	17380	32280
950,000 CM	1,501,700	1 41	1.1794	.01129	.05961	1381	7291	.7242	16510	30660
900,000 CM	1,422,600	1.38	1.1172	.01191	.06288	1309	6912	.7640	15640	29050
850,000 CM	1,343,500	1.34	1.0552	.01261	.06658	1236	6526	.8085	14770	27430
800,000 CM	1,264,400	1.29	.9924	.01340	.07075	1163	6141	.8600	13900	25820
750,000 CM	1,185,500	1.25	.9310	.01430	.07550	1091	5761	.9166	13030	24210
700,000 CM	1,106,300	1.21	.8690	.01533	.08094	1018	5375	.9824	12160	22590
650,000 CM	1,027,300	1.17	.8076	.01650	.08712	945.0	4989	1.0582	11300	20980
600,000 CM	948,400	1.12	.7448	.01787	.09435	872.5	4554	1.1460	10430	19370
550,000 CM	869,400	1.07	.6828	.01884	.09947	799.8	4223	1.2551	9560	17750
500,000 CM	790,400	1.02	.6208	.02144	.11320	727.2	3839	1.3733	8690	16140
450,000 CM	711,150	.97	.5586	.02383	.12580	654.4	3457	1.5282	7820	14520
400,000 CM	632,300	.92	.4966	.02680	.14150	581.7	3071	1.7192	6950	12910
350,000 CM	553,150	.86	.4345	.03064	.16180	509.0	2687	1.9648	6080	11300
300,000 CM	474,200	.79	.3724	.03574	.18870	436.2	2303	2.2927	5210	9680
250,000 CM	395,150	.72	.3103	.04289	.22650	363.5	1919	2.7511	4340	8070
0000 B & S	334,450	.66	.2627	.05068	.26760	307.7	1625	3.2500	3680	6830
000 B & S	265,250	.59	.2083	.06390	.33740	244.0	1288	4.0985	2920	5420
00 B & S	210,300	.53	.1652	.08060	.42550	193.5	1022	5.1680	2310	4290
0 B & S	166,850	.47	.1310	.10170	.53700	153.5	810.5	6.5150	1830	3410
1 B & S	132,300	.42	.1039	.12810	.67640	121.7	642.6	8.2170	1450	2700
2 B & S	104,900	.37	.0824	.16160	.85320	96.5	509.5	10.3633	1150	2143
3 B & S	83,190	.33	.0653	.20370	1.0760	76.5	403.9	13.0730	914	1700
4 B & S	65,980	.30	.0518	.25690	1.3563	60.7	320.5	16.477	726	1350
5 B & S	52,320	.26	.0411	.32390	1.7103	48.2	254.5	20.750	575	1070
6 B & S	41,490	.23	.0326	.40850	2.1570	38.2	201.7	26.180	456	850

Conductivity copper calculated for 98, Matthiessen standard scale.
Elastic limit aluminum=14,000 lbs. per square inch.
Ultimate strength aluminum=26,000 lbs. per square inch.

Table II gives the resistance and other properties of aluminum cable in sizes equivalent in resistance to standard sizes of copper from No. 6 B. & S. to 1,000,000 CM.

Table III gives the deflections which would occur at various temperatures without wind in three sizes of aluminum cable for various span lengths up to 1000 feet, the cable

velocity. It is safe to follow this table for all sizes of cable, for the larger sizes will have slightly smaller deflections without exceeding their elastic limit on account of their greater relative strength.

Aluminum is a highly electro-positive metal. Consequently great care should be taken where contact is made

TABLE III.—Deflections in Feet Without Wind. Aluminum Cable.

Rise above minimum temperature F degrees.	Span. 200 Foot			400 Foot Span.			600 Foot Span.			800 Foot Span.			Span. 1000 Foot		
	553,150 CM.	265,400 CM.	132,300 CM.	553,150 CM.	265,400 CM.	132,300 CM.	553,150 CM.	265,400 CM.	132,300 CM.	553,150 CM.	265,400 CM.	132,300 CM.	553,150 CM.	265,400 CM.	132,300 CM.
0 Degrees	.42	.45	.46	1.80	1.95	2.20	4.3	5.1	6.2	83.6	10.3	14.0	13.9	18.6	26.0
20 Degrees	.51	.52	.55	2.20	2.42	2.75	5.1	6.1	7.2	9.5	11.7	15.4	15.6	20.3	27.6
40 Degrees	.65	.65	.69	2.70	2.90	3.40	6.0	7.1	8.4	10.8	13.2	16.9	17.3	22.0	29.0
60 Degrees	.83	.85	.92	3.35	3.70	4.20	7.0	8.2	9.7	12.3	14.7	18.3	19.1	23.8	30.5
80 Degrees	1.07	1.13	1.30	4.15	4.50	5.10	8.2	9.5	11.0	13.8	16.4	19.6	20.8	25.5	31.8
100 Degrees	1.57	1.65	1.82	5.05	5.45	6.00	9.5	10.8	12.2	15.4	17.7	20.9	22.5	27.1	33.1
120 Degrees	2.20	2.27	2.45	6.00	6.40	7.00	10.8	12.0	13.3	16.9	19.1	22.2	24.2	28.6	34.4
140 Degrees	2.75	2.80	2.95	6.90	7.35	7.85	11.9	13.1	14.4	18.3	20.4	23.4	25.9	30.0	35.8
150 Degrees	2.97	3.03	3.10	7.20	7.78	8.50	12.5	13.6	15.7	19.0	21.5	25.5	26.7	31.5	37.5

Wire stressed to elastic limit at minimum temperature with 65 miles per hour actual wind velocity.

TABLE IV.—Deflections of Aluminum Wire Without Wind.

Deflections in Inches. Maximum Tension 14,000 Pounds per Square Inch at Minimum Temperature with Wind 65 Miles per Hour Actual Velocity.

Rise Above Minimum Temperature F. °	Length of Span					
	200 ft.	180 ft.	160 ft.	140 ft.	120 ft.	100 ft.
0	6.30	5.30	4.20	3.10	2.20	1.70
10	7.00	5.70	4.50	3.40	2.40	1.75
20	7.80	6.40	5.10	3.80	2.80	1.90
30	8.80	7.25	5.75	4.50	3.20	2.20
40	10.20	8.40	6.70	5.20	3.80	2.70
50	12.00	9.80	7.80	6.40	4.60	3.30
60	14.00	11.50	9.40	7.50	5.60	4.00
70	16.50	14.00	11.50	9.20	7.00	5.20
80	19.75	17.00	14.25	11.40	8.90	6.80
90	23.10	20.00	16.80	13.80	10.30	8.75
100	26.60	23.30	20.00	16.60	13.10	10.80
110	29.75	26.60	23.00	19.50	16.25	13.10
120	33.45	29.75	25.75	22.20	18.70	15.20
130	36.75	32.80	28.70	24.50	20.80	17.20
140	40.00	35.75	31.50	26.80	22.80	18.80
150	43.00	38.40	33.60	29.10	24.80	20.30

Calculations made for No. 2 B. & S. stranded conductor.

with other metals to keep the joint free from moisture, otherwise galvanic action will be set up which will rapidly destroy the aluminum.

The fact that aluminum is one of the principal constituents of the earth's crust leads one to believe that some day its cost will be very low. If that condition ever arrives aluminum will probably become the principal metal for the conduction of electric current.

STARTING A GENERATOR.

Run the generator for a short time with its field circuit open (the field can most conveniently be opened at the rheostat), noting, as in the case of the motor, whether the armature oscillates and the oil rings carry oil. Shut down and replace the field wire in the rheostat, and see that all field resistance is in circuit.

Bring the generator to normal speed, and then gradually cut out the resistance of the rheostat, until normal voltage is obtained. Now note the operation of the machine, and see if the armature still oscillates freely in its bearings; if so, the generator is ready for its load. In case the generator does not build up to voltage when the field resistance is cut out of the circuit (with the generator running at proper speed) it will be found that either the residual magnetism has been lost, or that the shunt fields are not properly connected. In the former case, separately excite the fields from some other source of power for a short time. If, on reconnecting the fields, the generator does not build up, it is probable that the fields are wrongly connected; in this case reverse the leads as indicated on the connection diagrams. Also examine the brushes carefully to see that they make good contact with the commutator. If the machine does not then build up to voltage, an electrician should be called in to locate the trouble.

When the generator is excited to normal voltage, close the main switch. In the case of a shunt wound generator, to maintain the normal voltage as the load increases, it will be necessary to cut some of the resistance out of the rheostat.

In the case of a compound wound generator, if, as the load is increased with the speed remaining constant, the voltage drops to any great extent, it is probable that the series coils are opposing the shunt, and it will be necessary to reverse the series leads.—Allis-Chalmers Instruction Book.

XII. THE MAINTENANCE ORGANIZATION.

Lecture delivered to the Class in Electrical Engineering by Mr. C. E. Fleager of the Pacific Telephone Company, on March 20, 1907, at the University of Washington, Seattle, Wash.

In talking tonight on the maintenance organization I have chosen this subject with the object in view of pointing out the necessary divisions of work and force necessary to keep the complete plant in repair up to the standard on which I assume the original plant has already been built and put in service. I also wish to give a few of the causes of trouble to telephone apparatus and what can be done to prevent and to clear them.

Last week's talk covered the central office portion of the telephone exchange plant, but I wish to again give the short summary of the divisions so that they may be fresh in our minds while dealing with the maintenance of the whole plant.

The central office was divided into the following divisions:

Building.
Protective Apparatus.
Main Distributing Frame.
Intermediate Distributing Frame.
Power Plant.
Switchboard.
Special Desks.

In addition to the central office divisions we have the following other divisions of the whole plant:

Underground Cable Plant.
Aerial Cable Plant.
Aerial Wire Plant.
Subscribers' Stations.

In taking up the maintenance of these divisions I am assuming that the work of all divisions is under the direction of one man whom I shall call the Wire Chief. It is best in my opinion to have all the work of these divisions under the direction of one man as their relations to each other are so interwoven it would only result in friction, no matter how closely the men in charge would co-operate were the responsibility divided. Of course, in some of the larger exchanges this work may become so heavy as to be too much for one man to attend to all the details. In such a case, I would still continue with one head who could have such assistants assigned to particular branches as are necessary.

The Wire Chief's natural question is "What men will I require, and what will the work be in each of the different divisions, and how can I organize to keep each branch going in proper unison with the others?"

Taking our first subdivision of the central office plant, the building, we find a thing which is common to most businesses, and while it will need thought and supervision on the part of the Wire Chief it is so common that I do not think we need to discuss it here. The men required will be one or more janitors, the number, of course, depending upon the size of the building and number of persons entering daily.

The protective apparatus, consisting of carbon arresters and heat coils, is subject to trouble due to disintegration of the carbon blocks or the opening of the heat coils. The first causes the telephone line to become grounded, resulting in the operators or line signals failing to clear properly, in the inability of the operator to ring the subscriber's bell or in the proper quietness of the line being disturbed, due to foreign electric currents entering the line from the ground or earth. This disintegration of the carbon is caused by the jumipng or loosening of a small particle of the carbon which lodges in such a way as to temporarily connect the two carbons, one of which you know is connected to earth and the other to one of the line wires. In clearing this trouble it is only necessary to remove the carbons and rub them on some nearly smooth surface, such as a piece of paper or soft cloth. This tends to wipe off any loose particles. To prevent the particles lodging, the mica, which separates the two blocks, is notched and the notch should be

placed so that gravity will tend to make the particles fall clear of the arrester.

This trouble does not occur with great frequency as only in the case of a general electric storm will the telephone wires become generally in contact with current of sufficient voltage to jump across the air gap. In the case of an electric storm, immediately after the storm has passed, the wire chief can assign men to examine and clean all carbons, but as ordinarily little trouble is experienced, very little help will be required for the regular maintenance.

The heat coil trouble is also of small magnitude and except in case of a general cross with some foreign electric current, such as trolley or electric light current, will not need special attention, the trouble being found on test of the usual complaint ticket and referred to rackmen or switchboardmen to clear. In case of general trouble, men engaged in other work can be temporarily placed to make inspection and clear the open coils found. In the case of self-soldering heat coils it will only be necessary to adjust the position of the coil. In the case of the non-soldering type, the heat coil is removed with the aid of a pair of special pliers, placed in the box marked "bad" and a good heat coil installed.

The maintenance of the main distributing frame and intermediate distributing frame will not be great outside of the changes in cross-connection wires necessary when telephones are moved from one location to another, connected or disconnected. This work, however, will require the attention of one man in medium-sized exchanges and two men or more in larger exchanges. While this work can be classed as strictly maintenance work, yet it can hardly be called construction work, and I am of the opinion it should be included under the general maintenance head. The changes made in the cross connections must be recorded, and as these records naturally fall to the wire chief's department to handle, they being the ones who deal with them constantly, the wire chief should be in charge of the parties making and recording the changes. This man, known as rackman, will do his work on written orders, usually in the form of blanks properly filled out by a clerk known as the line order clerk. He can also assist the testers in locating trouble on the lines by connecting test trunks to the proper lugs on the main distributing frame. This test trunk terminates in a piece of apparatus on the main distributing frame known as a "shoe." It is connected with a flexible cord and is so arranged that when the heat coils are removed it can be placed between the springs, allowing the tester to connect his testing apparatus to the outside or inside line or to connect the two together.

The rackman can also assist in clearing trouble in heat coils or carbons when the tester has located trouble there. The general maintenance of the racks consists of keeping the dirt and dust clear and in inspection of cross-connecting wires where they are connected to the terminals to see there is not liable to be trouble.

Such cross-connection wire as the rackman may disconnect should be pulled out of the frame, and if of sufficient length to be used again and undamaged should be hung up or coiled up for use in connecting new telephones. A supply of cross-connection wire should be placed on a spool free to revolve and located in a handy place. Soldering tools and solder should have a place in which to keep them, usually close to the soldering tool heater. It should be the rackman's duty to keep them in neat order.

The power plant is an expensive and important portion of the exchange and needs skilled attention. As charging is usually done during the daytime, a skilled attendant should have nothing else to take his attention but his machines and batteries. He should daily see that the emergency machines are in working order and that the usual working machines are not in need of repairs or attention. He should be supplied with record blanks on which to record daily use of machines and any remarks which might become of use at a future time in determining cause of trouble in any portion of the plant. He should also be supplied with a chart on which to record daily the work the storage batteries perform and discharge, and charge readings of specific gravity, voltage, temperature, etc. He should also note any change appearing in the batteries which might lead to trouble if not properly attended to. It should be this man's duty to see that his portion of the plant is kept clean, and tools, oil cans, waste, etc., in proper place and proper supply on hand.

The maintenance of the switchboard requires especial training on the part of the men employed at it. Its parts are delicate and unless trouble is properly cleared the results may be rapid depreciation. The parts of the switchboard are so numerous it will be practically impossible to give you all the causes of trouble. Some of the principal ones may be mentioned. Relays collect dust and their local contacts corrode or become dirty, resulting in poor contact when in operation or at rest, thereby causing the failure of the circuit to operate as it should. This can be prevented to a large extent by dust shields for each relay and overcome by cleaning the dust or corrosion away from the contact. This must be done carefully or the adjustment of the armature will be disarranged. Should this occur, it will be necessary to readjust and we should therefore be provided with some portable adjusting set. This set is made up in a convenient form with a handle and provided with keys to produce artificially the condition under which you wish the relay to be adjusted to. Proper tools should be used in adjusting relays systematically tested for adjustment. This can be done rapidly during the hours when the traffic is light (usually midnight to 5 a. m.). This systematic testing tends to head off any trouble of adjustment that might be appearing.

Cords are subject to constant wear and are liable to wear out or become in trouble at any time. A systematic test made every day should again be of service in anticipating trouble. Such trouble as is found either by this test or by failure of the cord during business hours should be cleared by the removal of the cord and substitution of another, the cord in trouble being repaired out of the board during odd moments or at another time by some employee to whom the work is regularly assigned.

Wiring of jacks, keys, relays, etc., may become damaged due to accidental reasons. This can usually be readily found by switchboardmen from trouble reported on the particular circuit in which it is located. An inspection of this wiring should be made at regular intervals by competent men to determine that all trouble has been properly repaired and to repair and put in order such as has not.

In locating touble in the wiring except in cases in the multiple, the trouble can readily be found by opening the cross-connecting wires and then inspecting the various points in the wiring where the trouble could occur. In case of trouble in the multiple this is not feasible, as in almost every case the wires are located out of sight in the pile of multiple cabling. Several methods can be employed in locating this trouble. One of the simplest requires the use of a battery and a telephone receiver. Battery is connected in series with one of the two wires that are crossed and the receiver is connected across the wires from jack to jack until in the jack in which the trouble is located the cross will not allow of current passing through the receiver while in all other jacks a certain portion of the current will shunt through the receiver. Opens are found with the use of the same apparatus. As most of the telephone circuits have one side of the battery connected to one wire and the other side on the other wire you can readily see what little apparatus is required.

The cleaning of the switchboard is an item often overlooked and in my opinion should receive regular attention from some employee. Dust collects easily in all of the multiple jacks, on cables under the board, etc. A compressed

air plant or vacuum pump would be of great assistance in this work. The switchboard frames should be polished regularly if the finish is to be kept up properly.

As the continued operation of the apparatus is desired, a competent man should be on duty at all hours who can immediately tend to any failure, such as the blowing of a fuse. This man can be repairing such trouble as is reported on the usual complaint ticket, as he would be around the switchboard within easy call at all times.

The various circuits, such as subscribers' line circuits, trunk circuits, operators' busy test circuits, etc., should be tested at regular intervals. This can readily be included with the cord and relay adjustment tests mentioned a short time ago. In fact, the portable test sets are usually wired to do this, using the maximum and minimum line resistances as a basis to work from.

The maintenance of the special desks is included in the maintenance of the switchboard as its class is exactly the same.

In the maintenance of the underground cable plant, we find that practically all our troubles come from one cause—the opening of the lead sheath, allowing water to enter and destroy the insulation of the wires. The insulation is now always of paper which draws water easily. The opening of the sheath may be caused by any one of several causes, the principal ones of which are cracks in the joints, careless handling of tools by workmen, working alongside the cables, malicious injury and electrolysis. The three former can not be prevented entirely, but of course can be minimized to a large extent by careful supervision. The latter can be prevented by proper tests often enough to eliminate injury. A method for finding if electrolysis is liable to be occurring is to make potential measurements of the cable sheaths, comparing it to the actual earth potential and to water pipe sewer and street car rail potentials. Where the current is found to be flowing between our cables and some other conductor in the direction liable to cause trouble a bond should be attached, thereby preventing any electrolytic action.

Insulation measurements should be made on conductors in all cables at frequent intervals in order to obtain, if possible, advance information as to coming trouble. When trouble actually shows up it is located by means of the Wheatstone bridge, and is cleared by removing the lead sheath from the damaged portion and boiling the cable in paraffine, thus driving away the water. If this is impossible, owing to position or extent of trouble, a new piece of cable is connected in place of the damaged piece.

If the exchange is of any size, it is well to keep one man constantly working on the cables with his Wheatstone bridge, as very often when the weather is dry one pair only of a cable will come in trouble, and, while he may not be able to locate what has caused the trouble, it may mean something serious when the first rain comes, and his measurements of the one pair may be the means of more quickly locating the trouble.

Underground cables should be inspected in the manholes at regular intervals. It is also well to patrol the underground each day to locate and stop possible interference with the cables by other companies digging in or across the street.

The maintenance of the aerial cables follows very closely that of the underground cables, and needs no further discussion.

The maintenance of the aerial wire plant should not be a large factor in the maintenance of the whole plant, as in modern systems the aerial wire is reduced to a minimum, an all-cable plant being desirable. The aerial wires should be given the proper amount of tension, the extremes of temperatures to be taken into account in determining the exact sag to be placed in the wires while constructing.

The aerial wire plant is very susceptible to sleet and wind storms. A special maintenance force will usually be required after such a storm, and can be drawn from the construction forces.

Our next subdivision, the subscriber's station, is one that next to the central office is in more danger of getting into trouble. It is also the part that gets the least educated handling, that is, it is the portion of the plant coming into close touch with the public and, of course, very often gets rough and careless handling. The construction of the subscriber's instrument can, to a great extent, overcome the difficulties and troubles experienced. All working parts, as far as possible, should be inside of the case or framework of the telephone. With the central energy system the only portion of a wall set that should have any great amount of wear would be the cord connecting the receiver. The receiver is the only portable portion of this set, and may become broken by careless handling, as may the transmitter mouthpiece, which is not of great strength.

With the desk, or portable set, the maintenance is usually considerably greater, as the whole set is not fixed or fastened, and easily gets knocked over.

In the handling of the maintenance of this portion of the plant I have found it to be my experience that better results can be obtained if a certain portion of the exchange is assigned to one man and he made responsible for the condition of it. His work should include the regular inspection to be reported to the Wire Chief at the time of inspection, and the line to be "Placed on test," and talking, ringing and resistance tests to be made. The condition of the instrument as to neatness, general appearance, wear, etc., should be recorded by the Wire Chief. The troubleman should be required to carry such tools and material as is necessary to place the instrument in as good order as when it was originally installed, if possible.

We have covered the principal troubles to be found and means of clearing same, so let us now look to the method and plan to be followed in collecting, recording, testing and reporting such daily troubles as occur. Naturally, our first thought must be to the method of collecting such trouble complaints as arise. As the public cannot distinguish between the various classes of trouble, we must refer all complaints to one department. This is what I have termed our complaint department. Such subscribers as have complaints to make should be referred and connected to this department, which is situated at a desk, termed the complaint desk. The clerk or operator of this desk should be sufficiently versed in the various kinds of trouble to readily obtain from the complaining party all possible useful information which information should be recorded on blanks provided for the purpose. After the blank has been filled out with all the information obtainable the party can be advised that the trouble will be properly attended to and cleared. The blank should then be assigned a serial number and the important information recorded in a book supplied for that purpose. Time of day at which the complaint is received should be recorded both on the blank and in the book.

If the complaint is of a service nature it should be referred to the operating department. If the complaint is due to defective working of any of the apparatus it should be immediately referred to the Wire Chief's desk for testing and clearing. The Wire Chief should have at this desk a number of testers who can immediately take the complaint ticket and place the line on one of his test trunks to determine where and what the exact trouble or defect may be. This tester, to obtain this information, must be familiar with the entire workings of the exchange, as well as familiar with his testing circuits, as upon his correctly ascertaining the location of the trouble will depend the quick removal of it.

When the trouble is determined and located the tester must assign the cause of trouble to the proper party for

attention. To do this he must ascertain the employee to whom has been assigned the particular district or class of trouble to which this case belongs, and when that employee is connected with the Wire Chief's desk the trouble can be referred to him for clearing. The desk should be provided with pigeon holes properly marked, so that the complaint ticket can be placed on file immediately when it is tested and assigned. As the trouble-man calls for test the record of such test should be made on the ticket and ticket again filed. When the trouble is finally cleared, the ticket should be endorsed with the time of day and cause of trouble and returned to the complaint department.

The complaint department will enter in their complaint book the information, endorsed by the Wire Chief, regarding time cleared and cause of trouble, and the ticket laid to one side to be filed with the balance of the day's tickets. As claims for damages due to trouble on the lines may occur, these tickets should be filed so they may readily be located again, although the exact date may not be known. In the case of a party line, the subscriber making claim may not have been the subscriber making report on the trouble. It is, therefore, necessary to file these tickets in numerical order in accordance with the circuits on which the trouble occurs. For convenience, they are usually filed in groups of one hundred circuits, each month separate.

I have spoken of the complaint ticket being of the proper form. What form should this be? One point I think has often been overlooked, and to me seems important, it being that unless the Wire Chief knows what trouble has existed previous to the case he is now working on, he is apt to overlook some important trouble. This is particularly true of trouble of an intermittent nature. Such trouble may be reported, yet when the Wire Chief tests the line he finds it working perfectly. This may occur time after time, and unless some one pays particular attention to it the trouble will still exist. A good way to overcome this, it seems to me, would be to have a trouble ticket for each circuit working in the exchange on file at the complaint desk. This ticket could be made up of sufficient size to allow ten to twenty-five cases of trouble to be recorded on the same ticket. When trouble is reported, the complaint operator can withdraw it from the file, endorse the new trouble on it, and, if the Wire Chief finds it O. K. on test, he can, by referring to the trouble that has previously been reported, know if it is some old condition needing special attention or if it is some case of trouble lasting only temporarily. This form of complaint ticket would also be of greater weight as evidence in the trial of damage claims.

Summing up the various men needed to handle the maintenance department, we might build up the following:

Wire Chief, testers, switchboard trouble-men, instrument trouble-men, power-plant attendant, rackman, line-order clerks, recording clerks, cable trouble-men, janitors.

San Francisco, Cal.—The proposed combined fresh and salt water system of fire protection of San Francisco was explained fully at a meeting held at the Merchants' Exchange last week, to which the special committee of the Merchants' Association had invited representatives of the Merchants' Exchange, Chamber of Commerce, Board of Trade, and Pacific Board of Fire Underwriters. From what was said at and after the meeting it appears that the project will meet with the approval of the business men and also of the insurance men whose interests claim consideration just now. The final approval of the insurance people will, however, be withheld until the arrival of Chief Engineer Robinson, of the National Board of Fire Underwriters, who is coming here from Chicago to look over the plans and suggest whatever modifications or improvements he thinks necessary.

CALIFORNIA MIDLAND RAILROAD.

Construction has been started on the roadbed of the California Midland Railway, which will connect the mines of Nevada and Placer Counties with Marysville. From Marysville the new road will extend thirty-four miles east to Limekiln Junction. From here one branch will be built south, seventeen miles, to Auburn, on the Southern Pacific Railway. A second branch will run twelve miles northeast to Grass Valley, which is joined to Nevada City by the Nevada County Traction Company's electric road. Hammond, the center of the Yuba dredging industry, will be connected by a one and one-half-mile spur from the main line at Marygold, eight miles east of Marysville.

The seventy miles will be operated with 1,200-volt, direct current, distributed between sub-stations by an underrunning, inverted-contact third-rail. Current will be purchased from the California Gas & Electric Corporation, which has hydraulic generating plants and 60,000-volt transmission lines in this territory. There will be four sub-stations of reinforced concrete, each equipped with a 400-kilowatt capacity motor-generator set, and the necessary step-down transformers. The motor-generator sets will each comprise one 60-cycle motor, direct connected to a 1,200-volt, 400-kilowatt generator. The sub-stations will be placed at Marygold, a point midway between Marygold and Limekiln, at Limekiln, and north of Auburn. The high-voltage alternating current will be stepped down and converted at each sub-station and distributed between the sub-stations through an inverted contact rail. It is proposed to use a special low-carbon steel rail weighing 22.4 pounds per yard. The section will have an inverted "T" form, being supported by channel-section brackets twelve feet apart. These channel-iron brackets will be spiked to the ties, and each will support a porcelain insulator, from which will hang a wrought-iron stirrup. The stirrups, in turn, will be keyed to the web of the inverted T-section. It is estimated that with this light rail section, permissible on account of the high voltage, there will be a weight of but 100 pounds to be supported by each insulator. The inverted T-section may carry, if necessary, four No. 0000 auxiliary copper feeders.

Low-carbon steel has a conductivity one-eighth that of the same cross-section of copper, consequently the equivalent cross-section of the underrunning steel rail will be 345,000 circular mils, and the conductor will offer a resistance, including bonds, of 0.16 ohm per mile.

Each passenger car will be equipped with four 75-horsepower, 600-volt motors, connected two in series for 1,200-volt operation. Potential relays will be shunted across the motor terminals, to eliminate possibility of trouble from the slipping of one motor of a pair. A pantograph trolley is to be used to supply current to the motors in towns where there are trolley wires, but in the open country the current will be taken up by four underrunning collector shoes. Compressed air will operate the brakes and control the changing from the third rail to the trolley. The cars will be fifty-two feet long. A block-signal system will be put in.

The line will run through a picturesque section of the Sierra Nevada foot-hills, and will open up not only the mines, but also a large agricultural country, to a cheaper and more direct transportation to market. The maximum grade will be one of three per cent. for seven miles. Several large bridges will be necessary, and, as surveyed, considerable cut and fill will have to be done. The Yuba River and marsh, near Marysville, will be crossed by a 9,000-foot trestle.

C. C. Manker, of San Francisco, designed the electrical system, under the direction of John Martin, president of the California Midland.

Electrical Construction for the Architect

CHANGES IN NATIONAL ELECTRIC CODE. APPROVED ELECTRICAL DEVICES.

Theatre Wiring.

Among other changes made in the National Electric Code at the recent meeting of the Electrical Committee of the Underwriters' National Electrical Association, was the abolishment of "Rule 65A: Moving Picture Machines," and the substitution thereof of "Special Rules and Requirements for the Installation of Wires and Apparatus for Electric Light, Heat and Power in Theatres where potential of system does not exceed 250 volts."

Special rules and requirements for the installation of wires and apparatus for electric light, heat and power in theatres where potential of system does not exceed 250 volts.

All wiring, apparatus, etc., not specifically covered by special rules herein given must conform to the standard rules and requirements of the National Electric Code.

In so far as these rules and requirements are concerned, the term "theatre" shall mean a building or part of a building in which it is designed to make a presentation of dramatic, operatic or other performances or shows for the entertainment of spectators which is capable of seating at least four hundred persons, and which has a stage for such performances that can be used for scenery and other stage appliances.

(a). Services:

1. Where source of supply is outside of building, there must be at least two separate and distinct services, and where practicable they must feed from separate street mains. The second service must have at least sufficient capacity to supply all emergency lights.

2. Where source of supply is an isolated plant within same building, an auxiliary service of at least sufficient capacity to supply all emergency lights must be installed from some outside source, or a suitable storage battery within the premises may be considered the equivalent of such service.

(b) Stage:

1. All permanent construction on stage side of proscenium wall must be approved conduit with the exception of cables to border and switchboard wiring.

2. **Switchboards.**—Must be made of non-combustible, non-absorptive material, and where accessible from stage level, must be protected by an approved guard rail to prevent accidental contact with live parts on the board.

3. **Footlights.**—Must be wired conduit construction, each lamp receptacle being enclosed within an approved outlet box, the whole to be enclosed in an iron trough, metal to be of a thickness not less than No. 20 gage, or each lamp receptacle can be mounted on or in the cover of an iron box so constructed as to enclose all the wires and live parts of receptacles.

4. **Borders:**

(a.) Must be constructed of iron of a thickness not less than No. 20 gage, treated to prevent oxidization, be suitably stayed and supported by a metal framework, and so designed that flanges of reflectors will protect lamps.

(b.) Must be wired conduit construction, each lamp receptacle to be enclosed within an approved outlet box, the whole to be enclosed in an iron trough, or each lamp receptacle may be mounted on or in the cover of an iron box, so constructed as to enclose all the wires and the live parts of receptacles, metal to be of a thickness not less than No. 20 gage.

(c.) Must be provided with suitable guards to prevent scenery or other combustible material coming in contact with lamps.

(d.) Cables must be continuous from stage switchboard to border, conduit construction must be used from switchboard to point where cables must be flexible to permit of the raising and lowering of border, and flexible portion must be enclosed in an approved fireproof hose or braid and be suitably supported.

Exception.—Junction boxes will be allowed on fly door and rigging loft in existing theatres where the wiring has been completed and approved by Inspection Department having jurisdiction.

(e.) For the wiring of the border proper, wire with slow-burning insulation should be used.

(f.) Must be suspended with wire rope, same to be insulated from border by at least two approved strain insulators properly inserted.

5. **Stage Pockets:**

Must be of approved type controlled from the switchboard, each receptacle to be of not less than fifty amperes rating, each receptacle to be wired with a separate circuit to its full capacity.

6. **Proscenium Lights:**

Must be so installed that they cannot interfere with the operation of or come in contact with curtain.

7. **Scene Docks:**

Where lamps are installed in scene docks, they must be so located and installed in such manner that they will not be liable to mechanical injury.

8. **Curtain Motors:**

Must be of iron-clad type and installed so as to conform to the standard rules and requirements of the National Electrical Code.

9. **Control for Stage Flues:**

(a.) In cases where dampers are released by an electric device, the electric circuit operating same must be normally closed.

(b.) Magnet operating damper must be wound to take full voltage of circuit by which it is supplied, using no resistance device, and must not heat more than normal for apparatus of similar construction. It must be located in loft above scenery and be installed in a suitable iron box with a tight, self-closing door.

(c.) Such dampers must be controlled by at least two standard single-pole switches, mounted within approved iron boxes, provided with self-closing doors without lock or latch and located one at the electrician's station and others as designated by the Inspection Department having jurisdiction.

(c.) Dressing Rooms:

1. Must be wired in approved conduit.

2. All pendant lights must be equipped with approved reinforced cord or cable.

3. All lamps must be provided with approved guards.

(d.) Portable Equipments:

1. Arc lamps used for stage effects must conform to the following requirements:

(a.) Must be constructed entirely of metal, except where the use of approved insulating material is necessary.

(b.) Must be substantially constructed and so designed as to provide for proper ventilation and to prevent sparks being emitted from lamp when same is in operation, and mica must be used for frame insulation.

(c.) Front opening must be provided with a self-closing hinged door frame in which wire gauze or glass must be inserted, excepting lens lamps, where the front may be sta-

tionary and a solid door be provided on back or side.

(d.) Must be provided with a one-sixteenth iron or steel guard having a mesh not larger than one inch, and be substantially placed over top and upper half of sides and back of lamp frame; this guard to be substantially riveted to frame of lamp, and to be placed at a distance of at least two inches from the lamp frame.

(e.) Switch on standard must be so constructed that accidental contact with any live portion of same will be impossible.

(f.) All connections in lamp and at switch and rheostat must be provided with approved lugs.

(Note: Referred for re-wording.)

(g.) Rheostat, if mounted on standard, must be raised to a height of at least three inches above floor line, and in addition to being properly enclosed must be surrounded with a substantially-attached metal guard having a mesh not larger than one square inch, which guard is to be kept at least one inch from outside frame of rheostat.

(h.) A competent man should be provided for each standard, and not more than two arc lamps should be mounted on one standard.

(Note: Referred for re-wording so that one man may have two lamps in charge if in sight of each other, and not more than ten feet apart.)

2. **Bunches:**

(a.) Must be substantially constructed of metal, and must not contain any exposed wiring.

(b.) The cable feeding same must be bushed in an approved manner where passing through the metal, and must be properly secured to prevent any mechanical strain from coming on the connection.

3. **Strips:**

(a.) Must be constructed of iron of a thickness not less than No. 20 gage, treated to prevent oxidization, and suitably stayed and supported by metal framework.

(b.) Cable feeding same must be bushed in an approved manner where passing through the metal, and must be properly secured to prevent any mechanical strain from coming on the connections.

4. **Portable Plugging Boxes:**

Must be constructed so that no current-carrying part will be exposed, and each receptacle must be protected by approved fuses mounted on slate bases and enclosed in a fireproof cabinet equipped with self-closing doors. Each receptacle must be constructed to carry thirty amperes without undue heating, and the bus-bars must have a carrying capacity equivalent to the current required for the total number of receptacles, allowing thirty amperes to each receptacle, and approved lugs must be provided for the connection of the master cable.

5. **Pin Plug Connectors:**

(a.) When of approved type, may be used to connect approved portable lights and appliances that do not require more than 660 watts.

(b.) Must be so installed that the "female" part of plug will be on the live end of cable, and must be so constructed that tension on the cable will not cause any serious mechanical strain on the connection.

6. **Lights on Scenery:**

Where brackets are used they must be wired entirely on the inside, fixture stem must come through to the back of scenery and end of stem be properly bushed.

7. **String or Festoon Lights:**

Wiring for same should be approved cable, joints where taps are taken from same for lights to be properly made, soldered and taped, and where lamps are used in lantern or similar devices, lamps must be provided with approved guards. Where taps are taken from cable, they should be so staggered that joints of different polarity will not come immediately opposite each other, and must be properly protected from strain.

8. **Special Electrical Effects:**

Where devices are used for producing special effects, such as lightning, waterfalls, etc., the apparatus must be so constructed and located that all flames, sparks, etc., resulting from the operation cannot come in contact with combustible material.

(e.) Auditorium:

1. All wiring must be installed in approved conduit.

2. All fuses used in connection with lights illuminating all parts of the house used by the audience, must be installed in fireproof enclosures so constructed that there will be a space of at least six inches between the fuses and the sides and face of the enclosure.

3. All exits shall be plainly indicated by a sign at each, the face to be illuminated and bear the word "Exit," the letters of which must not be less than four inches in height, and there must not be more than one set of fuses in any "Exit" sign circuit between service fuses and sign.

4. Exit lights and all lights in halls, corridors or any other part of the building used by the audience, except the general auditorium lighting, must be fed independently of the stage lighting, and must be controlled only from the lobby or other convenient place in the front of house.

(Note: Sections 3 and 4 will probably be re-worded so as to apply if exits are lighted by electricity.)

5. Every portion of the theatre devoted to the use or accommodation of the public, also all outlets leading to the streets and including all open courts, corridors, stairways, exits and emergency exit stairways, should be well and properly lighted during every performance, and the same should remain lighted until the entire audience has left the premises.

6. **Moving Picture Machines:**

(a.) Arc lamps used as a part of moving-picture machines must be constructed similar to arc lamps of theatres and wiring of same must not be of less capacity than No. 6 B. & S. gage.

(b.) Rheostats must conform to rheostat requirements for theatre arcs.

(c.) Top reel must be encased in an iron box with hole at the bottom only large enough for film to pass through, and cover so arranged that this hole can be instantly closed. No solder to be used in the construction of this box.

(d.) A box must be used for receiving the film after being shown, with a hole in the top only large enough for the film to pass through freely, with a cover so arranged that this hole can be instantly closed. An opening may be placed at the side of the box to take the film out, with a door hung at the top, so arranged that it cannot be entirely opened, and provided with spring catch to lock it closed. No solder to be used in the construction of this box.

(e.) The handle or crank used in operating the machine must be secured to the spindle or shaft, so that there will be no liability of its coming off and allowing the film to stop in front of lamp.

(f.) A shutter must be placed in front of the condenser, arranged so as to be readily closed.

(g.) Extra films must be kept in metal box with tight-fitting cover.

(h.) Machines must be operated by hand (motor-driven will not be permitted).

(i.) Picture machine must be placed in an enclosure or house made of suitable fireproof material, be thoroughly ventilated and large enough for operator to walk freely on either side of or back of machine. All openings into this booth must be arranged so as to be entirely closed by door or shutter constructed of the same or equally good fire-resisting material as the booth itself. Doors or covers must be arranged so as to be held normally closed by spring hinges or equivalent devices.

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EDITORIAL.

COMPARATIVE COST OF POWER FROM DIFFERENT SOURCES.

In a recent bulletin of the United States Department of Agriculture Professor C. E. Lucke of the Mechanical Engineering Department of Columbia University and S. M. Woodward, irrigation engineer, give a complete analysis of the cost of power from various sources, primarily for the purpose of contrasting the total cost per unit of output, using alcohol or gasoline and other fuels. Their conclusions are of more than ordinary interest to gas engineers and others connected with the introduction of gas or explosive mixture engines.

As set forth by the authors, the greatest source of power is fuel, and by far the largest part of the power being used comes from steam produced by the use of coal. In point of present use water power stands next to steam in importance, this being the case for two reasons, namely, that water power is among the earliest in point of development, but more largely due to the fact that it is now possible to transform water power into electrical power, which can be transmitted long distances, and so overcome geographical isolation of the sources of power.

Next in quantity produced stands power generated by the gas engine. The principal reason why the gas engine occupies this subordinate position is the fact that engineers have only recently discovered, and are today discovering, how best to build these machines and adapt them to the work they are to do.

The gas engine in its general sense includes all machines in which the fuel mixed with air is burned or exploded within the working chambers, whether the fuel be gas produced from coal, natural gas, vapors of any of the mineral oils, vegetable or animal oils, or alcohol.

The cost of producing power, no matter what the source, necessarily includes interest, depreciation, attendance, repairs, lubricants, and, except with wind, wave, or water power, fuel.

Eliminating water power, fuel is always a most important item, and it is found that labor costs do not differ so widely for the different systems, nor are they so large as the fuel cost. In power production, the lessening of the cost of fuel is of paramount importance.

Based on heat units, the following table is given as showing the cost of energy in fuels:

Fuel	Cost	B. T. U.	B. T. U. per $1.00
Large anthracite, ...	$6.25 ton	12,500 per lb.	4.500,000
Illuminating Gas.........	1.00 per 1000 cu. ft.	550 cu. ft.	550,000
Natural Gas	.10 " "	1,000 "	10,000,000
Crude Oil..................	.04 gal.	20,000 per lb.	3,650,000
Kerosene....................	.10 "	20,000 "	1,200,000
do	.30 "	20,000 "	400,000
Gasoline	.10 "	20,000 "	1,200,000
do	.30 "	20,000 "	400,000
Grain Alcohol	.30 "	12,000 "	270,000
do do	.40 "	12,000 "	200,000

The above table shows comparatively the cost of energy in heat units with different kinds of fuels. The thermal efficiency of the apparatus used for converting the heat energy into mechanical energy, or as is commonly termed power, affects the cost of fuel per unit of power. The following table, therefore, is of greater value to the power user or producer, as the resultant cost not only takes into consideration the cost of fuel but the efficiency of each machine using a particular kind of fuel.

Fuel and Plant	Fuel per H. P. Hr.	B. T. U. per H. P. Hr.	Thermal Efficiency %	Cost of Fuel	Cost in cts Fuel per H. P. Hr.
Steam Plant,.........	2 to 7 lbs.	25,000 to 100,000	10 to 2.5	$6.25 ton	.57 to 2.2
Producer Gas.......	1¼ to 2 lbs	14,000 to 25,000	18 to 10	$6.25 ton	.31 to .57
Illuminating Gas...	24 cu. ft.	12,000	20	$1. M cu.ft.	2.20
Crude Oil............	1.4 pts.	25,000	10	.04 gal.	.68
Gasoline	1.1 pts.	13,400	19	.15 gal	1.70
Alcohol................			19	.30 gal.	5.00

The above figures are based upon a cost of coal of $6.25 per ton. With this price of coal, the cost of fuel per horsepower per hour using the steam engine is .57 of one cent, but with the producer gas plant and gas engine and the same cost of coal, a horsepower hour cost but .31 of one cent.

With fuel cost but $2.50 per ton the corresponding costs are given as .25 of one cent for the steam engine and .14 of one cent for the producer gas plant and gas engine.

As a general conclusion, it must be said that the future of the gas engine using producer gas is most promising, especially in large units. For small isolated plants the crude oil and gasoline engines also have a great advantage over the steam engine, not only in smaller fuel costs, but also in attendance charges.

INDIVIDUALISM vs. SOCIALISM.

In a recent address before the People's Forum, at New Rochelle, Mr. Jacob G. Shurman, president of Cornell University, said:

"In recent times in all progressive countries the functions of government have been considerably enlarged. In the United States, for example, the view of government that has hitherto prevailed is that of an institution for the protection of life and property. It rested on the very wise theory that the less men were governed, the better. But the growing complexity of modern life and the multiplication of material commodities and the varying conditions under which they are produced and exchanged have compelled modern legislatures to enact laws on subjects not only inconceivable to their fathers, but transcending the limitations set by them for the scope of governmental activity. This necessity has produced a change in our attitude twoard the State. We have come to think of it, perhaps, in an exaggerated and dangerous degree, not merely as an institution for the protection of its citizens in their rights, but as an association for the positive promotion of the common interests of all its members.

"Laws for the protection of working people, and for the improvement of their condition, have rapidly increased, both in the United States and in Europe and Australasia. The lead in this so-called 'State Socialism' was taken by Germany, which adopted measures for the insurance of workmen against accident, sickness and old age. New Zealand, under the leadership of the late Richard Seddon, went still further in the same direction, and established in addition a system of compulsory arbitration in labor disputes. In this country and in England factory legislation may be mentioned as an illustration of the same tendency. And, in a different field, the Federal Railway Rate Bill, Pure Food Bill, and Meat Inspection Bill of last year, with their recognition of the need of Government supervision of certain kinds of private property, were by many people regarded as another example of State Socialism.

"For my own part I will add that the presumption is always against any extension of the functions of government, as government is already overburdened and the men who conduct it are not equal to the growing task, being neither demi-gods nor heroes, but mere human beings, little, if any, above the average of their fellows, either in ability or character. No fallacy is more pernicious than the complacent assumptions that a problem is solved when the task of solving it is put on the President, or Governor, Congressman, or Assemblyman, or some lower official of their selection or appointment. The State is not a wise, benevolent, and all-powerful earthly Providence.

"It is a widespread belief that certain political, social, and economical evils can be obviated or mitigated by public ownership of industries which in their nature are monopolistic. Under this conviction cities have become owners of waterworks, gas and electric light plants, tramways, and street cars, and States have purchased or constructed railway, telegraph, and telephone systems, and even undertaken the business of banking and insurance. * * * Now, I do not understand that any appreciable advance toward the millenium has anywhere resulted from the municipal or State ownership of public utilities, though I am far from opposing that system of ownership. I know that in London, where municipal ownership had been carried almost to an extreme, mismanagement, especially in connection with the street cars, the river boats, and the electric service, entailed such enormous municipal debts that the rates of municipal taxes were greatly increased, and the supporters of the municipal ownership policy were overwhelmingly defeated at the elections only a few months ago. I know that in Russia, which is the most perfect exemplar of State and municipal ownership, you find as a consequence a highly-centralized government and a corrupt bureaucracy which is not only morally reprehensible, but which yields in practice the worst service in the civilized world.

"I do not want to see a Government despotism in the United States. I dread the bureaucracy which Government ownership of American railroads would make inevitable. I can see nothing but folly in a policy which would call for Government loans of billions of dollars to purchase the railroads and which would entail the loss of billions of dollars in mismanagement and corruption under political control after the roads had been taken over by the Federal and State Governments. No Government in the world is qualified to go into the railway business, and least of all the Government of the United States, which draws its life from party politics and in which all administrations are necessarily short lived.

"The fact is that wealth is a creation. The colossal fortunes of the millionaires and billionaires, excepting, of course, those that have been dishonestly acquired, are positive contributions to the sum total of human wealth. These fortunes have been created from possibilities of Nature and human society divined by the genius and organizing ability of great captains of industry. The rest of us would not be the richer, but poorer, had these men of economic genius not created their vast fortunes. And I have no doubt that in the material world and in the needs of human nature there are still infinite possibilities of wealth open to any of us who have the genius and skill to utilize them."

TRADE CATALOGUES.

Bulletin No. 1060, from the electrical department of Allis-Chalmers Co., Milwaukee, Wis., describes the new line of machines, designated as Type "AB," which this company is now building for plants in which a belted generator of not exceeding 150 kilowatts output is required. They are of the revolving-field, "self-contained" type, the two bearings being carried with end housings bolted to the stator yoke, the feet of which rest directly on the slide rails. They have no bed plate and the construction is, therefore, somewhat lighter than in Type "AH" belted generators, which are provided with a base and pedestal bearings.

B. F. Sturtevant Company, Hyde Park, Mass., send Bulletin 146, illustrating and describing electric propeller fans, for use whenever large volumes of air are to be moved agianst very low resistances.

PERSONAL.

A. F. Menzin, of San Francisco, has taken a position with the Pacific Power & Light Co. at Redondo, California.

G. B. Euler is superintending the machinery installation in the new plant of the Pacific Power & Light Co. at Redondo.

John E. Van Hoosean of the Sonoma Water and Light Company, Sonoma, Cal., has been in San Francisco during the past week.

J. H. Hallberg, designer and manufacturer of flaming arc lamps and other electrical specialties, has moved from 45 Broadway to 30 Greenwich avenue, New York City.

R. L. Jaynes lectured before the salesmen of the California Electric Works on the Diamond H switch of the Hart Manufacturing Company of Hartford, Con., on May 9th.

J. J. Kline, formerly with the Stanley Electric Co., at Chicago, has been appointed assistant superintendent of the Fort Wayne Electric Co., at Fort Wayne, Indiana.

INDUSTRIAL

WATER-TIGHT TELEPHONE SYSTEM FOR BATTLESHIPS.

The following description and illustrations relate to the special telephone system designed and built by the Holtzer-Cabot Electric Company, Boston, Mass., for the Naval De-

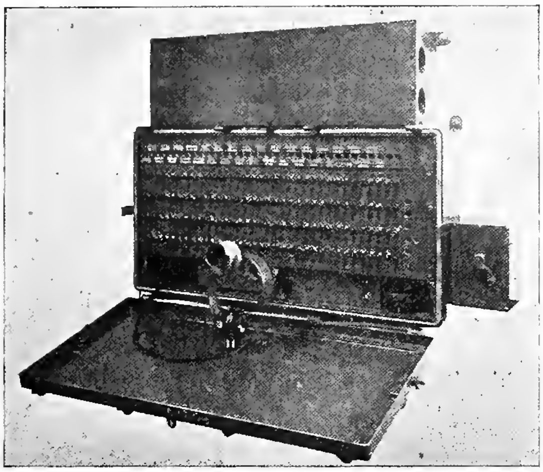

FIGURE 1

partment of the United States Government. Five similar systems were purchased by the Government and installed upon the following battleships: "California," "South Dakota," "Milwaukee," "Indiana" and the "Connecticut." To meet the spe-

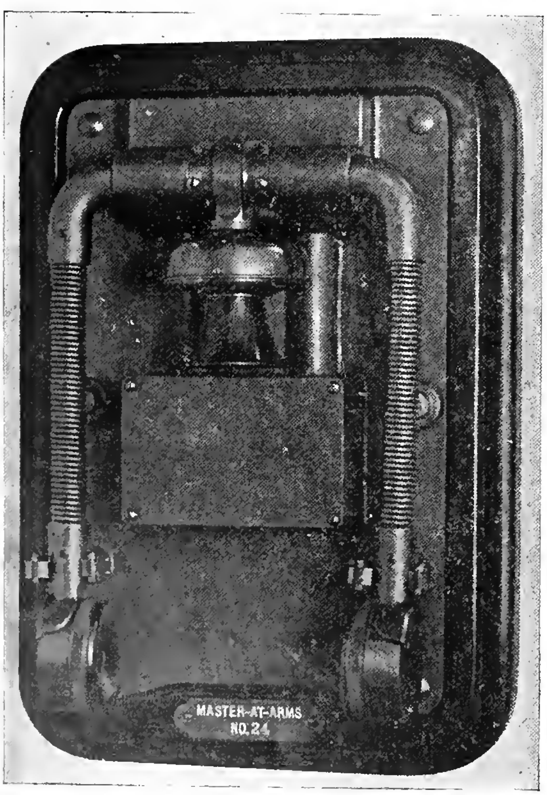

FIGURE 2

cially severe conditions which obtain on shipboard there were incorporated a number of novel and original features.

It was especially desired that the instrument be unaffected by the action of the air, the movement of the vessel, or the concussion of the heavy guns, and the switchboard and exposed stations were to be absolutely water-tight.

Figure 1 represents one of the water-tight stations. The operating parts are mounted on a frame plate which can readily be removed from the case without the use of tools and without disturbing any of the connections. One of the distinctive and original features of this station is the double receiver, the two receivers operating independently of each other so that either or both may be used. The act of raising one of them to the ear brings the transmitter into the proper position for talking and signals the switchboard. When released all parts return to their normal condition, making it impossible for any user to leave the telephone connected to the line. The receivers are of the watch case type, double pole, with metal cases, the coils being specially treated to make them waterproof. The transmitters are of the solid black type, the chamber being hermetically sealed, there being used nothing that will be affected by the moisture. The arm will support a weight of 200 pounds. The case which encloses the station is of composition, polished and oxidized and provided with a channel into which is fitted a moulded gasket of pure rubber.

The non-watertight stations (figure 1) are interchangeable with the watertight 'phones, the operative parts being mounted upon a mahogany base instead of a metallic case.

With each station there is furnished a separate watertight vibrating call bell. The design of the mechanism of this bell is distinctly special, the blow being delivered to the gong through a phosphor bronze diaphragm, which is reinforced so that there is no danger of its being worn through by use. The parts of the bell are made of non-oxidizable metal with the exception

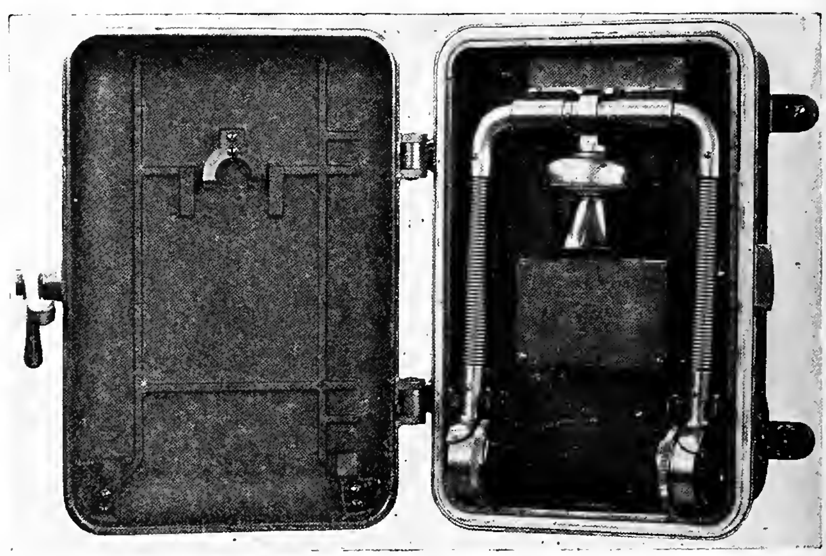

FIGURE 3

of the iron and steel parts, which are copper plated and lacquered to prevent corrosion.

The operative parts of the switchboard are mounted in a heavy brass case, shown in figure 3. This is gasketed so that when the cover is closed it is absolutely watertight. The case is divided into two compartments, the upper containing the terminals and the lower the switchboard proper. The upper part of the case is drilled for 2-inch conduits. The terminals

are of heavy copper lugs and are insulated with mica. A distinguishing feature of the board is that the connections are made without cords, there being used specially designed keys instead. The front of the switchboard is sub-divided into vertical strips, each holding four keyes. By taking out two screws any one of these strips may be removed, exposing for examination every contact and connection on the strip. The whole front which supports the case and signals is hinged at the bottom, so that it may be readily let down, allowing the cables to be examined. A supervisory signal is provided with each connecting circuit, the purpose of which is to indicate when the conversation has been finished.

Provision is made for connection with shore exchanges, the signaling current being obtained from a hand power generator which is held in the box shown at the right of the cut. The system will work in connection with either a common battery or a magneto exchange.

Current for the transmitters is taken from a Holtzer-Cabot motor generator of the noiseless type. These circuits draw their current directly from the motor generator, there being no storage batteries. The ringing current is obtained from the ship's ringing dynamotor, or in case of disability, from an emergency set of dry batteries. The system operates on a three-wire circuit and five conversations can take place at the same time, or any number of stations can be connected and an order transmitted simultaneously to them from any other station.

The system as a whole has been built with a special view to ruggedness so that nothing short of actual violence can cause injury.

STORAGE BATTERIES IN THE SAN FRANCISCO FIRE.

The San Francisco Gas & Electric Company's Stevenson-Street plant was situated within the fire zone of the fire following the earthquake of April 18th, 1906. In this plant were installed engines, generators, transforming apparatus, and in a separate room three storage batteries. Two of the storage batteries were installed on the ground floor and one on the floor above.

STORAGE BATTERY ROOM AFTER THE FIRE

The illustration shows the condition in the battery room shortly after the fire. In the foreground are a number of lead covered cables in process of re-installation. Back of these stand the rows of cells on the ground floor, partially covered in the center by debris from a section of the second floor which had fallen in. Each cell consisted of lead plates immersed in dilute sulphuric acid contained in a lead-lined wooden tank. Owing to the intense heat, the wooden tanks were completely burned away, but the circulation of the acid which remained at a comparatively low temperature prevented the lead linings from melting, thus protecting the vital part of the battery (the plates). The lead connecting lugs of the plates projecting above the acid were melted, and most of the copper bar connectors dropped down on top of the cells, but a large proportion of the plates on the ground floor were uninjured, and are now being re-installed by the Electric Storage Battery Co.

A larger proportion of the plates on the second floor were destroyed, on account of the floor having fallen in, thereby bursting the lead linings, which allowed the plates to be exposed to the heat.

The San Francisco Gas & Electric Co. also had three sub-station batteries located at different points in the burned region. These batteries were completely covered by fallen walls, and it was at first supposed that the batteries were destroyed, but upon investigation a large number of plates were found to be uninjured, having been protected in the same manner as described above.

A NEW CONCERN DEALING IN POWER PLANT EQUIPMENT.

L. D. Armstrong and Wm. M. Kreling have returned to San Francisco after securing a fine line of agencies for the newly organized Armstrong-Kreling Machinery Co., with temporary offices at 2815 Washington Street, San Francisco. They expect to be in the down-town machinery center within the next week. As dealers in high grade power plant equipment they will handle the following machinery, of which we append a brief description:

The ROLLINS ENGINE, of 29 Mason Street, Nashua, N. H., is a high grade, heavy duty, automatic, four-valve engine noted for its efficiency, durability and perfect regulation. They represent in design advanced ideas of modern engineering, and, in construction, the best results attainable from carefully selected and skillfully handled materials.

The ERIECO ENGINE, of Erie, Pa., is a modern designed high speed automatic engine, equipped with the Ribblet automatic governor, assuring close regulation.

The OSWEGO-McNAULL WATER TUBE BOILER, of Oswego, N. Y., is a flange steel sectional header water tube boiler. Each header consists of a flat tube-sheet and a flat hand-hole sheet, not flanged, but riveted to an extra heavy wrapper of channel form; sheets stayed with hollow stay-bolts 1¼ inches in diameter, spaced with 6-inch centers. The method of obviating flanging is peculiar to the Oswego boiler, and is fully covered by patents.

The EPPING-CARPENTER, of Pittsburg, STEAM PUMPS AND CONDENSERS, built for all services, the pumps being equipped with balanced piston valves and lost motion adjustment. They embody the latest and best designs approved by modern engineering practice.

The GOLDEN-ANDERSON VALVE SPECIALTIES include clean-seat globe and angle valves, which cleans its own "seat and disc"; cushioned non-return valves for boiler protection; patent float valves for railway standpipe service; roller lock railway blowoff valves and altitude valves especially adapted for buildings.

The MARINE ENGINE AND MACHINE COMPANY'S Groshon high duty compound crank and fly wheel pumping engine, especially adapted where large quantities of water are to be handled where the best efficiency is required.

The BURKE ELECTRIC CO., of Erie, Pa., belted and direct connected three-wire D. C. generators, embodying new features in this type of machine and variable speed induction motors for two and three phase.

NEWS NOTES

ELECTRIC RAILWAYS.

Portland, Ore.—The Portland Railway, Light and Power Company will extend and improve their system.

Calgary, Alta.—A by-law to raise $250,000 was endorsed by the rate-payers for the purpose of constructing a municipal street railway.

Walla Walla, Wash.—The Walla Walla Valley Traction Company will soon commence construction work on the proposed extension to Wallula.

Seattle, Wash.—Two more cars have arrived for Fred E. Sanders' road and will be put on the run between Ballard and Lake McAleer. Grading between McAleer and Hall's Lake has been completed and track laying will be commenced at once.

Spokane and Inland Empire Electric Railway Company—Work has been started on a depot at Hayden Lake, where a structure of Swiss chalet style will be erected. It will have a waiting room 30 by 30 feet, an office 12 by 12 feet and a baggage room 14 by 20 feet. It will cost $20,000. D. A. Miller has been named agent.

Inter-Valley Traction Company—Work has been begun on the first line in the Yakima Valley of Spokane. The line will be two miles in length, and its completion will mark the first link in the chain of suburban lines which will radiate from North Yakima. President H. B. Doudden announces that the directors had decided to begin work with a small force, but the crew will be enlarged from time to time until a large force is at work in many places.

Spokane and Big Bend Electric Railway—Col. W. H. Plummer of Spokane was elected president of the company, the secretary being Thomas Hye, at a special meeting of the stockholders representing 90 per cent of the capital of the concern. The directors are: F. B. Gregg, S. J. Hollans, Solmon Mayer, D. R. Cameron and the officers named. By unanimous vote the stockholders indorsed all of the contracts entered into by the president or the board of directors, and all the proceedings, on behalf of the company, which has been carried out and performed by the old officers. The company has begun work on a line into the Big Bend wheat belt, west of Spokane, having connections into Spokane over the Spokane and Inland Empire Electric Railway.

F. O. Adams of Chicago, president of the Spokane Western Power and Traction Company, and Mrs. D. W. Iden of New York, were married at the parsonage of Westminster Congregational church a few days ago. Rev. Dr. A. E. House, pastor, read the service. Mr. Adams came to Spokane from Chicago last September to take charge of the Spokane, Western Power and Traction Company, which will construct a line over the Spokane smelter right of way to the northwest. During the time that he has been in Spokane he has made many friends among the business men of the city. Mr. and Mrs. Adams will make their home in Spokane.

The Columbia and Walla Walla Traction Company—Former Governor Miles C. Moore, president, gave out the following statement in Spokane a few days ago: "While we are not out with brass bands announcing our intentions, we have been quietly at work getting everything in proper shape for the financing of the project, after which we will be all ready to begin active construction work on the Farmers' electric line, which will give the farmers of Walla Walla and Columbia counties a direct line to the seaboard and the benefit of low water competition on grain and all other farm products. This line has been all surveyed and practically all of the right of way secured for the entire distance, and I am in touch with syndicates in the east who will be glad to finance the project, or furnish what money we will need over and above the stock that will be taken by local capitalists, who propose to retain a controlling interest in the road. The statement to the effect that we may abandon the road is, therefore, to say the least, premature."

Spokane, Wash.—Forty million dollars will be expended by eastern capitalists in the building and equipment of 1000 miles of electric lines in eastern, central and western Washington, the company planning also to supply towns between Spokane and Tacoma with water, light and power. The foregoing announcement is made by P. P. Carroll of Seattle, representing the syndicate, which, he says, has begun work on three lines. This plan includes the completion of the proposed Puyallup Valley Northern Rapid Transit Railway at a cost of $2,500,000, also the completion of the Snohomish Valley Railroad, upon which construction work has started. This line will cost $3,000,000. A third line is the Seattle, Chelan and Spokane Railway. A company was recently chartered for the purpose of constructing this electric line. The cost is placed at $7,500,000. The Puyallup Valley Northern Rapid Transit Company has been incorporated nearly two years. Fred Chamberlain of Puyallup is its president, and John Mills is a prominent promoter of the line. A few months ago the incorporators of this railway closed a deal with an eastern firm of contractors whereby their electric line will be built in exchange for $2,500,000 worth of stock in the enterprise. Under the present plan it is understood that when these independent lines are consolidated this $2,500,000 in stock will be transferred to the consolidated company and a like amount of the big concern's stock issued to the railway builders. The Puyallup Valley line will extend from Tacoma to Puyallup, Sumner, Renton and other towns. It will traverse the valley between Tacoma and Renton, but will be constructed along the foothills, on an elevation high enough to remove the line from the flood district. The line conects at Renton with the Snohomish Valley Railroad, which line runs through Cherry Valley to Snohomish and north to Bellingham. The line passes through Monroe. It is being built by the same interests who have taken charge of the construction of the Puyallup Valley Railway, and construction work on the line is now in progress.

From the Sound, through Renton and east to Spokane, the Seattle, Chelan and Spokane Railway will be constructed. The application for a charter for this line was filed a few weeks ago. This is a sister proposition to the Puyallup and Snohomish Valley railways.

The men who are backing these enterprises have decided they can build and profitably operate the lines in connection with numerous power plants to be operated by water power. The plants will be located at towns along the lines of railway, and will furnish power for commercial and municipal uses as well as for the operation of the lines of railway. The richest agricultural sections in Washington will be penetrated by these railways, together with great tracts which have been valueless until recently, but which are now being rapidly populated because of government irrigation development.

TRANSPORTATION.

Guadalajara, Mex.—Carlos M. de Landero, manager of the Bank of Hidalgo, has concessions to use the water of the Tuxpan River. He will organize a company and build a power plant.

Los Angeles, Cal.—An ordinance has been adopted by the Council, giving J. Harvey McCarthy a franchise to construct and operate an electric railroad upon a portion of Indiana Avenue.

Chihuahua, Mex.—According to report from Parral, McQuatters & Truehart, the contractors, will start work grading for the electric street-car lines in that city within sixty days.

Grass Valley, Cal.—Surveyor W. W. Waggoner and a crew of six men are engaged in running the line for a ditch from near North San Juan to a point below the Delhi mine. The ditch will be about ten miles long and will take water from the Middle Yuba River. It is not known for what purpose the water is intended, but there is a rumor that a new power company is arranging to put in a plant.

Los Angeles, Cal.—Back of the trip of the Board of Public Works and the city engineer to Griffith Park recently is thought to be a strong desire on the part of the Los Angeles-Pacific Railroad to gain entrance to the park. The company desires a franchise for a road, one mile in length, within the boundaries of the park, it is said, and it is believed that the proposed road would be very popular.

Oakland, Cal.—The Oakland Traction Consolidated has filed an application for a street railroad franchise extending from Perry Street and Pleasant Valley Avenue over Lake Shore Avenue, Lake Park Avenue, and Lake Avenue to Grand Avenue, where it will connect with the present Grand Avenue line. The purpose of the proposed line is to open a new section of Piedmont to street railway traffic. The ordinance is in the hands of the Street Railroad Committee.

Napa, Cal.—The report is confirmed that Henry Brown, who was granted a franchise two weeks ago by the Board of Supervisors to operate and maintain power lines over the county, is representing a number of San Francisco capitalists in the matter and that a company will be formed to compete with the Bay Counties Power Company. The Great Western Power Company may be behind the deal, and will prove a strong competitor if this is the case. The fact that the lines extend to the extreme northern border of Napa County encourages the belief that Cache Creek will be the source of power.

Napa, Cal.—Manager L. J. Perry, of the Napa Valley Electric Railway Company, has set at rest the stories which have been going around that the new Napa and Lakeport Railroad, which is incorporated to build a line from Lakeport through Napa to Tiburon, has purchased the local road. Manager Perry said that overtures for the purchase of the road and the Monticello Steamship Company, running from Vallejo to San Francisco, have been made, but neither the road nor the steamers are on the market. The work of completing the extension of the electric road from this city to St. Helena is being hurried along and service is promised by August 1. The new cars will arrive early in June.

Eureka, Cal.—Superintendent M. M. Martin of the Humboldt Transit Company has received word from George Hazleton of San Francisco that about two miles of rails have been purchased for the extension out Myrtle Avenue and Broadway in this city. The expectation is to have the Myrtle Avenue division ready for operation in thirty days. Just when the Broadway line will be completed is not certain. Linemen will be put to work on Broadway when the Myrtle Avenue extension is well under way, the supply of overhead material being so small that nothing will be done on any other section of the road until it is sure that enough is on hand for the east end. Two new cars are expected by the latter part of May.

Santa Rosa, Cal.—An application for a franchise to distribute electric current for lighting, heating and commercial uses all over Sonoma County was presented to the Board of Supervisors last week by Cashier Frank M. Burris of the Santa Rosa Bank. While it is not stated, it is believed that the Eel River Power Company, which has for years been developing a plant in Mendocino County, is behind the project. The application states that the wires will be strung from the Mendocino County line through Cloverdale, Geyserville, Healdsburg, Lyttons, Windsor, and Fulton to Santa Rosa; from this city west through Cloverdale, Glen Ellen and Sonoma to the Napa County line, and from this city south through all the towns to Petaluma, and thence to the Marin County line.

Oakland, Cal.—By September the Alameda Mole train system running trains to Oakland and Alameda will be operated by electricity. Two ferryboats will be built and put on the run in order to give a twenty-minute service to the Alameda Mole. Fifty large electric cars are now being built in St. Louis. As soon as these changes are made the work of converting the Oakland Mole ferry system into electric lines will be begun. General Manager E. E. Calvin of the Southern Pacific Company has announced the changes the company contemplates. He has ordered built the fifty cars of more than usual length and seating capacity, which will be run in trains on the eleven or twelve miles of ferry lines running to the Alameda Mole. Plans for the two new ferryboats have been drawn, and the contracts are to be let within the next week or two. "These two ferryboats," says Manager Calvin, "will be built after the design of the Berkeley, but will be much faster. It takes three boats to maintain the present twenty-minute service to the Oakland Mole. We have now a thirty-minute service in connection with the Alameda Mole. The two new boats will move fast enough to give the Alameda Mole a twenty-minute service. The fifty standard electric cars just ordered will have double platforms and exits and they can be emptied of eighty to one hundred passengers in a minute and a half. The company will have its own power house to generate power to operate the Alameda Mole system. The same power station will also supply electric power for the Oakland Mole system. The Alameda mole electric line to Oakland will run as far as Fourteenth and Franklin streets, while the one through the city of Alameda will run just beyond the Park Street station. In connecting the Oakland Mole lines to Berkeley, Alameda and Oakland, we will preserve the system as it now exists, the Oakland line going through to Melrose."

WATERWORKS.

Sonora, Cal.—At the recent meeting of the Board of Trustees a petition was presented by the Union Construction Co. for the privilege of laying pipes in the streets for water supply. The matter was laid over.

Oakland, Cal.—Inability to purchase at a reasonable figure a site for the pumping plant for the auxiliary salt water pipe system has caused delay in forwarding plans for the installation of the plant. In the past tax levy budget, $27,000 was provided, but the money is not available owing to the extraordinary expenditures which were forced upon the city government as a result of the big fire. City Engineer Turner said that $15,000 had been demanded for a site that seemed suitable, and that the Board of Public Works considered the amount too large.

TELEPHONES.

Albany, Ore.—The Home Tel. Co. is to place some of its wires under ground.

Monida, Mont.—The Centennial Tel. Co. has been organized to build a line to Lakeview.

Vancouver, Wash.—The East Mill Plain Tel. Co. has decided to extend and enlarge its service.

North Yakima, Wash.—The County Commissioners have granted a franchise to the Cowichee Tel. Co.

Anaconda, Mont.—The installation of the new telephones of the Rocky Mountain Bell Co. is now in progress.

Dayton, Wash.—The Smith Hollow Tel. Co. has about completed its line, as has also the Delaney Company.

Olympia Wash.—Telephones will be installed in every room at the Hotel Kneeland. J. E. Goldsmith, manager.

Moyie, B. C.—The new switchboard for the local telephone exchange has arrived, and will be installed at once.

Victoria, B. C.—Large extensions are being planned for the local office of the B. C. Tel. Co. R. B. McMicking, manager.

Joliet, Mont.—The Bell Tel. Co. has leased the upper floors of the Meyer Block, and are fitting it up as their central office.

Echo, Ore.—The Butter Creek Tel. Co. has installed 'phones in the main offices of the reclamation service, along the East Umatilla project.

Maple Falls, Wash.—The Maple Falls Tel Co. has completed the construction of its line to Bellingham, where it will connect with the Sunset.

Olympia, Wash.—The Brighton Park Tel. Co. has been organized by E. Munn, Harry Drewery, Ed. Drewery, Hugh Williams, A. G. West, Ben Shinke, E. Elliott, George Irwin and Fred Lewis.

Bellingham, Wash.—The Home Tel. Co. is rapidly completing the installation of its system here. Six crews are now stringing the drop wires to the houses of the patrons. J. B. Middleton states the system will begin operating about June 1st.

Seattle, Wash.—The Independent Tel. Co. has completed the construction of its new long distance lines between here and Tacoma. The long distance line building from Seattle to British Columbia is completed as far north as Edmonds. Work on the extension of the local system to South Park will be completed in two weeks.

Sacramento, Cal.—Work has ceased on the improvements planned by the Sunset Telephone Company in Placer, Butte, Colusa, Nevada, and other counties of Northern California, and the company has discovered that the reconstruction means an immense outlay of capital. In the three weeks that the company has been doing no outside work there has accumulated the sum of $870,000. It is estimated that the company will save nearly $1,000,000 a month by the cessation of its outside operations.

Spokane, Wash.—Another independent telephone company has been organized in the Grangeville district in Idaho, southeast of Spokane. The line will be operated on Comas prairie at Red Rock precinct and from Dryden postoffice to the reservation line. The commissioners have granted a franchise for the use of highways. The company's officers are: T. A. Hughes, president; H. J. Gormen, vice-president; T. Robison, treasurer; F. W. Davis, secretary; M. R. Rogers, manager, and J. A. Johnson, E. Dunn and Ben Robison, building committee.

Spokane, Wash.—E. E. Crandall, manager, and John Weber, electrician of the Interstate Co-operative Telephone Company, at Kendrick, Idaho, southeast of Spokane, are installing the new large switchboard and connecting the American Ridge, Little Bear Ridge, Big Bear Ridge, Bed Rock Canyon, Cameron and Leland farmers' line in the central office here. This gives all the surrounding farmers telephone connection with Kendrick and through Kendrick with all the northwest territory. The Pacific States Telephone Company has for some time been making efforts to get the farmer lines to connect with them, but after many meetings they have decided to cast their lot with the Co-operative Company.

Spokane, Wash.—Active operations on the farmers' telephone lines into Gifford, Idaho, southeast of Spokane, are under way and are expected to be completed in a short time. The lines are being put up in a substantial way. Thirty-foot red fir poles are being put up on the main line from Summit to a mile beyond Gifford. Another line runs to Rigger's sawmill, four miles east of Gifford, and another across Jackson's Canyon via Summit. The switchboards, now at Lookout, will probably be moved to Gifford.

Spokane, Wash.—Farmers living along Wilson Creek and in the south Hollow district near Dayton, Wash., are making arrangements for the construction of a rural telephone system, from that portion of the country, and another will be built from the Tucannon district, 18 miles in length and will require with the double wire system 40 miles of copper. Both lines have arranged to connect with the Pacific States system at Dayton.

Spokane, Wash.—Announcement is made that the Home Telephone Company will begin construction work on its $60,000 building at Second avenue and Howard street in a short time, and it is expected to have the structure in readiness for the installation of apparatus late next fall or some time during the winter. Plans, prepared by Albert Held of Spokane, show a main building 71 feet on Howard street, 100 feet deep, two stories high with full basement. The material will be light brick and steel reinforced concrete. The partitions will be of hollow tile and the exterior trimmings of terra cotta. Light for the second story will be by means of specially constructed roof lights. The apparatus will have a capacity for 10,000 connections. The first floor will contain the business offices, while the automatic switchboard will be on the second floor, where will also be the storage battery and machinery rooms. Electric motor and gas engines will be installed to insure perfect service. The wires in the business section have been put under ground, while those in the resident districts are to be strung on poles, 3000 of which are awaiting erection. The company has also received other material and machinery at its warehouse in Division street.

REMOVAL NOTICE.

Barton, Squires, Byrne, Inc., dealers in hose, packing, leather and rubber belting, have removed from 27 Commercial Street to 533 Howard Street, San Francisco, California.

ILLUMINATION.

Fullerton, Cal.—The Fullerton Gas Company has ordered three carloads of pipe and has commenced work on installing a gas system for this city.

Los Angeles, Cal.—Chas. Orpin is at the head of a syndicate which will establish a gas plant at Searchlight, Nev. Crude oil will be used to produce the gas.

Seattle, Wash.—The Seattle Lighting Company wants a franchise to manufacture and distribute gas at Georgetown. F. K. Lane, the manager of the company, is taking up the matter with the Georgetown Council.

Eureka, Cal.—The Humboldt Gas and Electirc Company has been granted permission by the City Council to install an illuminating gas distributing system in Eureka. The company is a branch of the North Mountain Power Co.

Tacoma, Wash.—W. A. Aldrich, the general manager of the gas works, has given the information that he is actively preparing to extend the gas mains and that South Tacoma will have a gas system, to be installed at once at a cost of $60,000.

Escondido, Cal.—D. F. Garrison, president of the First National Bank of San Diego, Herbert Engle, C. H. Burlock and Clark Braley, capitalists of San Diego, were in the valley a few days ago with a view of putting in an electric power and lighting plant for the city and valley.

Santa Maria, Cal.—At a meeting of the City Board of Trustees last week the Santa Maria Gas and Power Company made application for a franchise which will enable it to put in an independent electric light and power plant in connection with the gas it now supplies for heat and fuel purposes. This is in opposition to the Valley Electric Company, against which there was considerable complaint in the past because of the service and the high rates charged.

Alturas, Cal.—Arrangements are being made by the Alturas Electric Light and Power Company to put in a larger waterwheel for its plant than the one at present driving the dynamos on Pine Creek. Other parts of the machinery will also be enlarged to correspond. This change is necessitated by the increased demand for power and light in Alturas, but more particularly by the new system being installed at Cedarville.

Los Angeles, Cal.—The City Gas Company, of which A. Ross is the general manager, has applied for a permit to erect a building on the twenty acres of land it has purchased in the Huntington Park Extension No. 2. The company proposes to lay the foundations at once and expend $400,000 on the plant. Much of the material has been purchased. The company has contracted with the Stacy Manufacturing Company of Cincinnati for two holders. The mains will be laid as soon as the work is commenced on the plant.

Los Angeles, Cal.—The Fuel Oil Gas Company has signed contracts and begun the installation of its system after thorough public demonstration. Its distillate generators manufacture oil gas upon the premises at the rate of commercial gas, but the industry will boost the refining business. The company is building tank wagons for delivery.

Santa Maria, Cal.—At the meeting of the City Board of Trustees last week the Santa Maria Gas and Power Company made application for a franchise which will enable it to put in an independent electric plant in connection with the gas it now supplies for heat and fuel purposes. This is in opposition to the Valley Electric Company, which is now supplying the town with electricity.

CLASSIFIED LIST OF ADVERTISERS.

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Rix Comp Air & Mach. Co.

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National Brake & Electric Co.

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Ohmen Engine Works
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OIL.

San Francisco, Cal.—At the offices of the Southern Pacific and Santa Fe it has been announced that a change has been made in the rate on refined oil from points east of the Missouri River to the Pacific Coast. The former rate was 78½ cents per 100 from Chicago, with a charge of $105 for the return of the empty car. The new rate is 90 cents per 100, with no charge for the return of the car. The effect of this change is to reduce greatly the freight rate on refined oil. The new rate was put into effect following a protest made to the Interstate Commerce Commission by oil men of Pennsylvania and Ohio.

Fresno, Cal.—Among the independent oil operators there is a plan on foot for the construction of a pipe line from Kern River through Coalinga to tide water near San Jose. Unless the Standard, the Associated and the Southern Pacific come to terms they state that this plan will surely be carried out. The freight being paid by the Standard and the Associated has gone up steadily, and the independents think it is time to put a stop to it. Last week a meeting was held in Coalinga beween the Fresno County independents and a committee of five from Bakersfield. The matter will be taken up again in a week. Two years ago the Producers' Union obtained a right of way for a pipe line running from Coalinga to tide water. This will be used for a part of the route.

Portland, Ore.—According to Captain E. W. Spencer, oil has been discovered on Fifteen Mile Creek, five miles above Dufur, Ore. Captain Spencer says: "I had heard talk about oil oozing out of the ground along Fifteen Mile Creek for some time and thought I would take a few days off and look the field over. The reports have been exaggerated. I found plenty of indications that led me to believe that there was good merchantable oil there. The formation of the soil, which consists of sandstone and shale, is such as one would naturally expect in an oil country, and is very similar to that found in West Virginia, with which I am quite familiar. I am inclined to think that the oil along Fifteen Mile Creek is of a very much lighter grade than that found in California, but I haven't gone far enough into the analysis to state this with certainty."

Bakersfield, Cal.—It is persistently rumored among oil men of authority that the Associated Company has crowned its recent thirty-cent contract with the McKittrick producers with a renewal of the former contract with the Southern Pacific Company to sell this same oil to the railroad for fifty cents a barrel. No confirmation of this rumor can be obtained from the Associated, but it is considered very probable by oil men that the deal has been made. The old contract with the Southern Pacific expired in April. With the increased demand for fuel oil and nearly all of the fluid tied up by contracts, an even higher price than that named is to be considered soon.

CLASSIFIED LIST OF ADVERTISERS—CONTINUED

The JOURNAL OF ELECTRICITY
POWER AND GAS
WITH WHICH IS INCORPORATED
The Engineers, Architects' and Builders' News

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THE

Journal of Electricity, Power and Gas

WITH WHICH IS INCORPORATED

The Engineers' Architects' and Builders' News

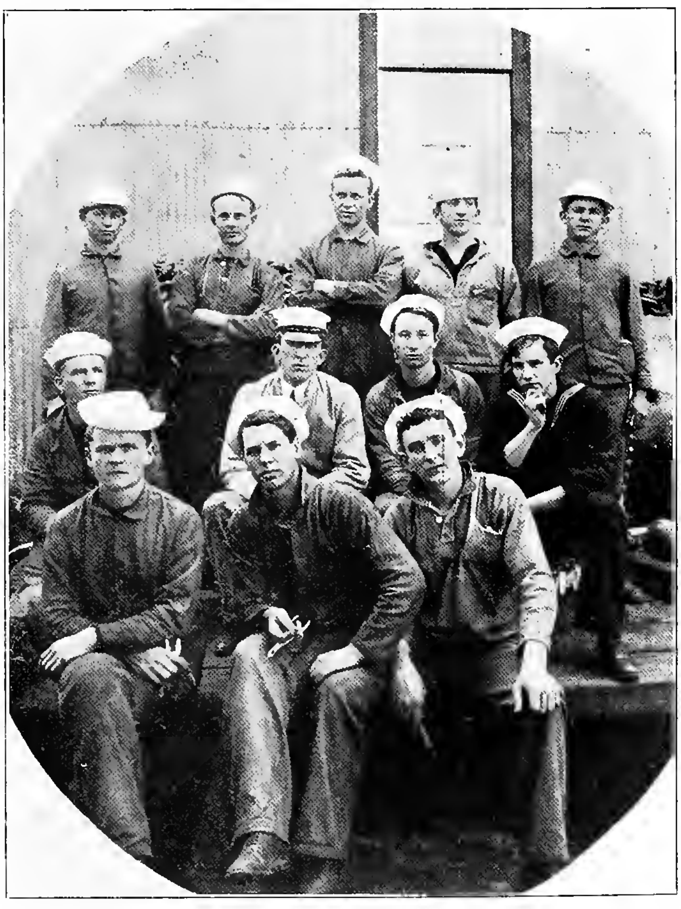
VOLUME XVIII. SAN FRANCISCO, CAL., MAY 25, 1907 No. 21

THE ELECTRICAL SCHOOL, NAVY YARD, MARE ISLAND.

Commander H. C. Gearing, U. S. Navy.

In the Journal of Electricity of June 9, 1906, reference was made to the Electrical School established at Mare Island to help fill the navy's need of electricians, employed both afloat and on shore and at wireless telegraph stations. This school was opened in March, 1905, and since then it has sent out into service as general electricians and wireless operators one hundred graduates.

By general electrician is meant a man capable of filling all the electrical duties that arise on board a man-of-war, including dynamo tending, detection of grounds, care of all electrical apparatus, and making of minor repairs. Wireless operators, of course, are those whose duties lie with the wireless telegraph, with which all our men-of-war above 2000 tons displacement are now equipped. It is required that all electricians in the navy must qualify in both branches. That is, the general electrician must be familiar with the wireless apparatus, know the code and be able to manipulate the key and receive a message; on the other hand, the operator must understand electricity, be capable of dynamo-watch standing, and, generally, of taking part in the ship's electrical duties. Therefore qualifying marks in both branches are required for promotion in the service and for graduation from the Electrical School. But the value of specialization is recognized especially in the school and students are encouraged along that line wherein they give most promise.

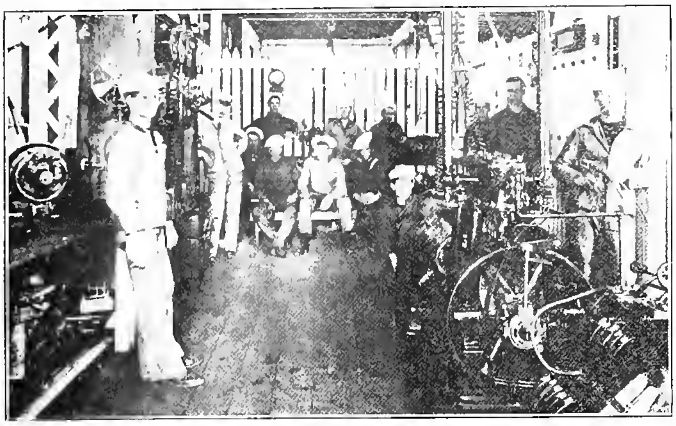


FIRST CLASS IN SCHOOL, MAY, 1905.

The inauguration of the school was coincident with the beginning of wireless telegraphy in the Pacific. And happily so; for, with the exception of one or two operators, all those manning the ten wireless telegraph stations now established on the Pacific Coast, the station at Honolulu, and the one at Guam are manned by graduates of the Mare Island school. No other source could have provided them. The need for these operators was pressing and continues so, for graduates have found places also on the ships of the Pacific and Asiatic squadrons. Of the one hundred graduates about one-half are wireless operators.

It must be understood that all are electricians arranged in the various classes or grades with pay varying for the different classes. The discrimination between general electricians and operators is one that is made by the officers in charge, based on the men's records and adaptability. What the different electrician ratings are and the pay of each will be noted later.

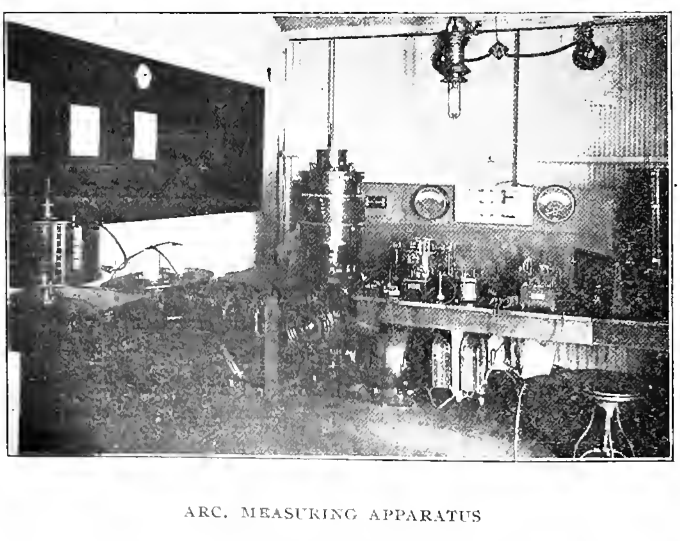
The course in the school lasts five months. It is not an elementary one, for the young men taken into it must be either electricians by trade or men who have had experience in handling dynamos or other electrical apparatus or who possess some knowledge of telegraphy. The course is wholly practical. No text work at all is required. The hours are from 8 to 11:30 a. m. and from 1 to 3:30 p. m. for five days in the week. The students are quartered on the receiving ship Independence, with excellent food and bathing facilities. A reading room, tennis, handball, baseball, football and track athletic grounds are near by. While no textbooks are used in the school, book-work is counted of value in a young man's improvement. He is supplied with excellent, up-to-date manuals on electricity and wireless telegraphy and has access to a growing library on mathematical and technical subjects, of which the student body is encouraged to make full use in the ample leisure time left from school hours. The city night school in Vallejo is open to them and permission to attend is easily obtained. No great literary qualifications are



ELECTRICAL SCHOOL, MAY 1905

demanded, except that for operators it is exacted that they must be able to spell decently and frame a message in intelligible sentences.

The course is a practical one. It aims to have the young man know the construction and manipulation of electrical machinery by tearing it apart and putting it together, actually handling the parts, and then operating it. The apparatus now installed—dynamos, motors, oil engine, switchboards, storage batteries and the many electrical ship appliances—have all been put in place by the students, the machines being those which have been found as unfit or not needed for ship use. These have been torn out of the ships, the parts cleaned and overhauled, and then been mounted again, all the work being done by the school. As a result, there are at present eight dynamos of various sizes and nearly as many types, an oil engine, several motors, several storage batteries, etc., all in good working order. Two generators that had been placed in first-class condition were sent to a ship at another navy yard, and others will be similarly disposed of to make room for two generators recently taken out by the class from a vessel that is about to be sold. It is thought that no instruction can be so valuable as this tearing apart and putting together when the shortness of the course is considered. All the many electrical appliances found on a ship, taken from vessels repairing, are placed in the school by the class, and when needed are removed, to be replaced by similar appliances belonging to other ships. This is considered equally valuable instruction, for it is to be remembered that there is a continual flux of students, some leaving while others are entering. The school assists in tests in the electrical laboratory con-

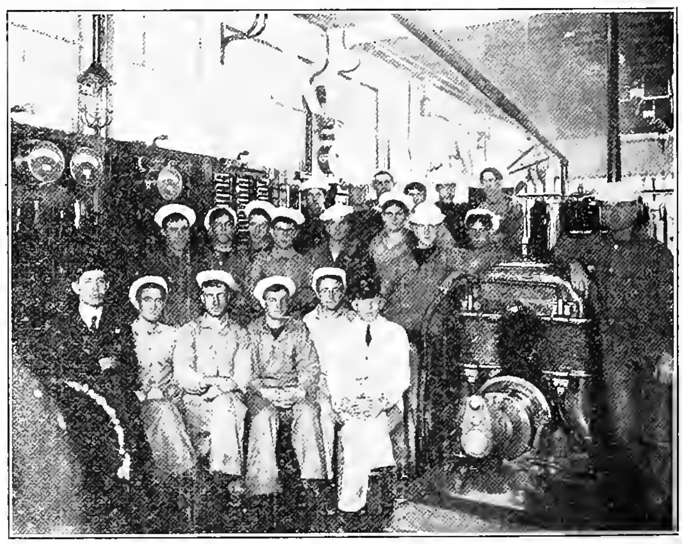


ARC. MEASURING APPARATUS

nected with the navy yard, and with one of its own dynamos keeps the storage battery in the laboratory charged.

Entrance is made at any time and there is no vacation time. No specific course can be laid down to be rigidly followed, for, besides entering at different times, the students also enter with widely differing degrees of preparation.

For instruction in wireless telegraphy the school has a 120-foot mast by which messages can be exchanged between the school and the wireless stations at the navy yard, Yerba Buena and the Farallon Islands. The school can not be said to possess any sending apparatus of its own, for no sooner have the students installed a set after alteration or repair than it has been found necessary to turn it over to some ship or shore station and begin the process of setting up another. This is beneficial rather than disheartening. New sets received at the yard for issue to ships or stations are set up and tried out. Experiments with different forms of aerial wires and receiving instruments are made, and here care must be exercised to see that this is not overdone. At first a room was specially fitted up for experimenting, to which the more advanced students had access. It was found that they neglected their practice with the sending key and receivers in order to indulge in curious experimentation. The room had to be closed in consequence, for the object is to



ELECTRICAL SCHOOL, MAY 1907

make proficient operators, and this can be done only by incessant practice.

Room for the school has been found by crowding into a building devoted to another use. It is pleasant to note that the work of the school has been appreciated and that money has been appropriated which will permit renovation of the present building and permits its being used wholly for school purposes.

Electricians in the navy are divided into the following classes, with pay for each class as shown:

Chief electrician	\$60 to \$70 per month
Electrician, first class	50 per month
Electrician, second class	40 per month
Electrician, third class	30 per month
Landsman for electrician	16 per month

Enlistment is for four years.

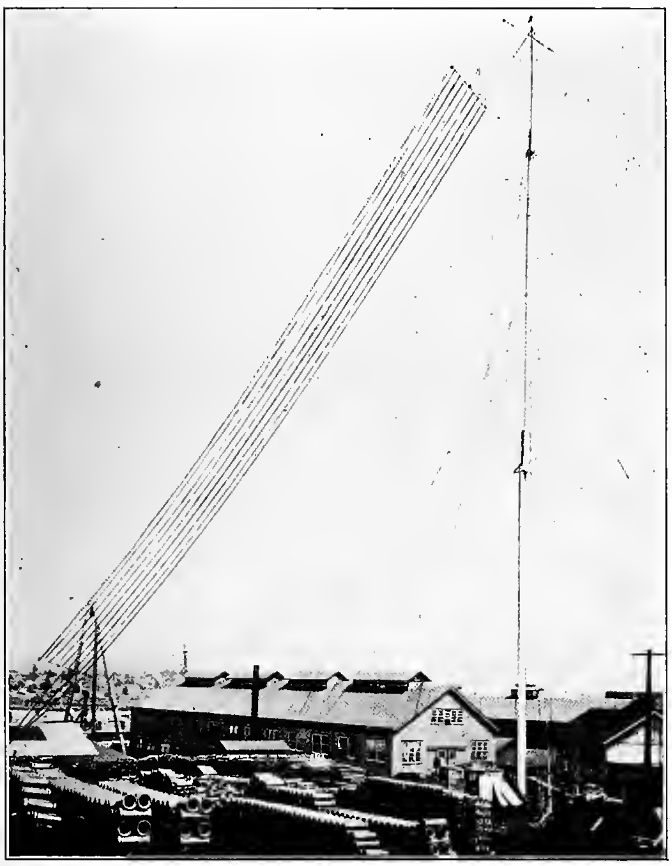
In addition to the above pay, the emoluments of these grades, as for every man in the navy, are increased by an allowance on enlistment of \$60 for clothing outfit, lodging, food, medical attendance and hospital, a pension in case of

physical disablement and a pension to family in case of death. Besides the above, there is the privilege of retirement on seventy-five per centum of current pay and allowances at the end of thirty years' service.

Applicants for enlistment as electricians must be electricians by trade and all first enlistments must be as electrician, third class. Any time after enlistment an electrician, third class, may be promoted to second class on favorable report after an examination in general electricity and wireless telegraphy, showing that he is qualified to stand a watch in charge of the dynamo room and to send and receive wireless messages. Promotion to electrician, first class, follows after a year if the second-class electrician shows that he is well grounded in the construction and use of all electrical apparatus on board ship and possesses a considerable skill in either branch.

To be eligible to the rate of chief electrician, in addition to the above, a first-class man must show a knowledge of the care and use of storage batteries and oil or gas engines. Lately some service at sea in a navy vessel has been added to the needful qualifications for the rate of chief electrician.

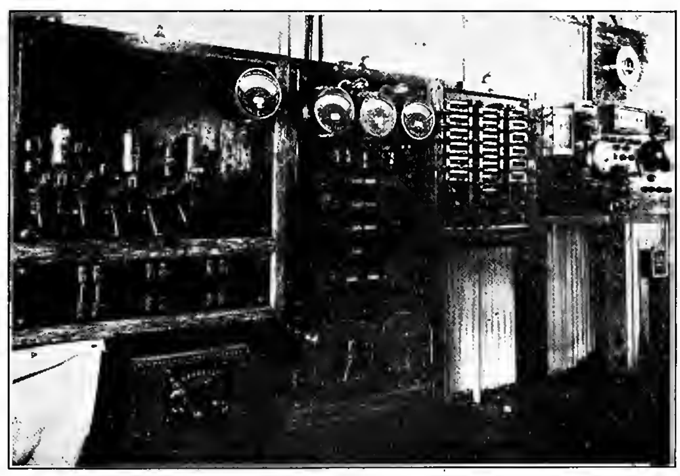
WIRELESS TELEGRAPHY CLASS



WIRELESS TELEGRAPHY MAST

In cases where applicants for enlistment in the electrical branch show some knowledge of electricity or telegraphy, but not sufficient to enable them to take up immediately duties as general electricians or wireless operators they are enlisted as "landsmen for electrician" and are sent to the school. The pay of landsmen is $16 per month. After successful completion of the course these landsmen are immediately promoted to electrician, third class. This is equivalent to the Government's giving a young man five months excellent technical schooling and opportunity for study, supporting and paying him for it at the same time.

There have been all classes of electricians on the rolls of the school from chief electrician down. With all, except chief electrician, promotion of one class is accorded on successful completion of the course. Provision is also made whereby a student who shows himself exceptionally well qualified may be advanced two classes. Only young men of good character, industrious habits and correct behavior, with some ambition to advance themselves, are desired. Very little weeding out has been necessary. A glimpse of the intelligent faces of those now in the school and the creditable records of its graduates show how well the school has maintained its standard.



SWITCHBOARDS

MEETING NOTICE.

The next meeting of the Association of American Portland Cement Manufacturers will be held at the Hotel Chamberlin, Old Point Comfort, Va., June 10, 11 and 12. There will be no papers read.

THE MOORE VACUUM-TUBE LIGHT AND THE LUMINOSITY OF GASES.*

By C. J. Thatcher, Ph. D.

The past few years which have witnessed a rapid improvement in the arc and incandescent forms of electric lighting have also seen the commercial application of a new and distinct type of lamp; that is, the enclosed vapor or vacuum-tube lamp. Three forms of this type have become generally known. The first of these is the Cooper Hewitt, which is now widely used and well understood; a second is the Bastian, which, like the former, is a mercury vapor arc lamp, but of smaller dimensions and provided with an incandescent carbon filament lamp to provide red light rays; the third is the Moore vacuum tube. Since the latter has recently given evidences of commercial practicability and is perhaps not thoroughly understood, a brief description of it and consideration of its salient features will be given here. It will be shown, also, that certain phenomena observed in this tube may have an important bearing on the question of the nature of gaseous luminosity in general and one which has not been previously recognized.

Mr. D. McFarlane Moore began to experiment about twelve years ago for the purpose of producing a "cold light"; that is, one in which all the electrical energy would be converted into light without any loss in the form of heat. At that time the maximum lighting efficiency was obtained with the arc lamp, consuming one watt per candlepower. Dividing this value into the theoretical figure for the conversion of electrical energy into light as given by Dr. E. F. Roeber—one spherical candlepower per 0.115 watt—we see that only about ten per cent. of the electrical energy is converted into light in this form of lamp, the other ninety per cent. is dissipated and lost in the undesirable form of heat.

Since then, however, illuminating art has been much improved, so that we now have a maximum lighting efficiency of fifty per cent. in the flaming arc lamp, which consumes only 0.23 watt per candlepower. The most efficient form of the Moore light, that is, the one in which rose-red light rays predominate, has a maximum efficiency of about three-fourths watt per candle, and is but little better than that of the older form of arc light. The heat loss is, therefore, about eighty-five per cent. in the most efficient form of the vacuum-tube lamp.

Description of the Moore Vacuum Tube.

Although the "cold light" problem, therefore, is still unsolved, Mr. Moore's experiments have finally produced a novel and fairly efficient form of illumination, and one which possesses distinct advantages for some purposes. As it is now being installed it consists of a continuous stretch of one and three-quarter-inch glass tubing of any desired length; this is supported near the ceiling by suitable brackets and encircles the room or space to be illuminated.

This continuous length of tubing is made in situ by joining together six or eight-foot lengths, and at the corners previously shaped angle pieces. The joints of the tube are made in the manner long used for joining large-bore glass tubing in making chemical and physical apparatus; the blow-pipe employed is a slightly modified and movable form of that, having two impinging flames, which has long been used for that purpose.

The ends of the one-piece tube thus formed come together in a box about two feet square, which is suitably and inconspicuously placed. These ends are constructed of slightly larger-bore tubing for a foot or so, and are, of course, rounded and sealed at their extremity. They each contain an electrode of carbon electrically connected with the exterior by platinum wires sealed in the end of the tube.

These wires in turn are in electrical connection with a transformer, which raises the voltage of the alternating-current supply to 10,000, at which pressure the current is delivered to the tube.

Another essential part of the system, also placed within the box, is an ingenious vacuum regulator. This consists of a cone-shaped carbon pencil, sealed point upwards in the end of a narrow glass tube, sealed in turn to the main tube. Surrounding this carbon pencil and sealed to the narrow inlet tube which carries it, is a glass tube of larger diameter. The annular space thus formed contains enough mercury to cover the entire pencil, and in this mercury a metal tube displacer floats, attached at its upper end to the core of a solenoid placed above the regulator and in the lighting circuit.

The tube thus completed is evacuated by a Geryk or other mechanical vacuum pump to a pressure stated to be about 1/40,000 of an atmosphere. With the passage of the high-tension alternating current the tube immediately becomes luminous throughout, the light being a soft one with rose-red rays predominating.

A suitable manometer was first attached to similar tubes several years ago, which, however, were not then provided with a pressure regulator. It was then found that the rare faction of the gases in the tube slowly increased, and this was accompanied by perplexing resistance changes, which finally culminated in the failure of the light.

In order to secure a permanent light it has been found necessary, therefore, to admit very small portions of air to the tube at intervals. This is accomplished by the vacuum regulator which was devised subsequent to the measurement of pressure variations. When the air pressure decreases the internal tube resistance also decreases; more current flows though the solenoid of the regulator, and the core thereupon rises a trifle, withdrawing the displacer so that the mercury falls enough to uncover the tip of the carbon pencil.

This is thereby exposed to atmospheric pressure, and a small bubble of air, to which the pencil is not impervious as it is to mercury, filters through the carbon; the normal vacuum and resistance are thereby restored and the mercury rises again, shutting off the air supply. Practically normal tube conditions can be thus maintained indefinitely, and tubes thus automatically controlled have had a life of 1,000 hours or more.

The circuit is conducted through the Moore tube from terminal to terminal solely by the highly-rarified gases, and these alone are the source of the light it emits. The Moore light, therefore, is only a lengthened Geissler tube; its light may at times exhibit striated effects similar to those of this tube, but ordinarily these are not noticed by the eye.

Mr. Moore has, therefore, made a practical application of a mode of producing luminous effects which has long been known; which, indeed, was one of the earliest forms of light produced by electricity. Now that this form of light bids fair to have a commercial value, it is to be expected that the nature of it may be the subject of more frequent, or, at least, more successful, scientific investigation, for, strange to say, little is definitely known concerning the source of the luminosity of conducting rarified gases.

Theories of Gaseous Luminosity.

It will be interesting to note here the theories regarding luminiferous gases recently advanced by different investigators in this field. The older theory is that the gaseous molecules send out vibrations of a visible wave length as a result of purely physical collision or heat effects consequent on electrical conductivity. Regarding this theory, Prof. H. A. Armstrong, in 1902, in an article on "The Conditions Determinative of Change and of Electrical Conductivity in Gases, and

*From "Electrochemical and Metallurgical Industry."

on the Phenomena Luminosity," stated: "An argument which I think will sooner or later be regarded as of weight in favor of the view that the phenomena are electrolytic in their origin, is afforded by the luminous manifestations in vacuum tubes. These can scarcely be mere collision effects or mere heat effects. It has long seemed to me that luminosity and line spectra are the expression—the visible signs—of the changes attending the formation of molecules from their atoms, or, speaking generally, that they are the consequence of chemical changes, a chemical change being one which involves an alteration of molecular composition, or it may be of molecular configuration, as it is conceivable that even changes involving isodynamic (tautomeric) molecules—changes in molecular structure unattended with change in molecular size—may give rise to such manifestations." Prof. Armstrong believes gaseous luminosity to be the result of chemical activity, therefore.

Prof. J. Stark, of Gottingen, on the other hand, who has made extended researches in this field, believes it to be a purely physical phenomenon, according to the following translated statement: "The line spectrum of a gas has its source of energy in the kinetic energy of the particles of the ionized gas, its conduction in the positive ion atoms. * * * The band spectrum of a gas, on the other hand, probably has its source of energy in the potential energy which the positive and negative ions possess in respect to one another, and which on recombination can be changed, at least partly, into light energy."

But a third authority, Dr. C. P. Steinmetz, in an address before the American Institute of Electrical Engineers, on "The Transformation of Electric Power Into Light," in November, 1906, stated, regarding Geissler and vacuum tubes: "The mechanism of this light production does not seem to be known, but the light seems to be somewhat of the character of a by-product."

What May Be Learned from the Moore Light Concerning Luminous Gases.

It has not been recognized, so far as I am aware, that the observed constant decrease of gaseous pressure in the Moore tube may have an important bearing on the question as to the cause of the luminosity of the gases contained in the tube, and, indeed, of conducting gases in general. As has been already stated, it has been found necessary to feed the tube with air at frequent intervals. As a matter of fact, very small portions are added every minute or so during use. This, of course, can mean nothing else but that chemical reactions are occurring which result in an increase of molecular size, and therefore in a decrease in the number of molecules and of the volume of gas.

The substances in the tubes in considerable amounts which might cause such reactions are, of course, nitrogen and gen and the carbon of the electrodes. Of the known reactions into which these might enter, those involving cyanogen formation, either as an intermediate or as an end product, cannot cause reduced pressure. The formation of ozone from oxygen, on the other hand, would cause reduction in the number of molecules and a higher vacuum. Ozone, however, is rapidly decomposed into oxygen again at temperatures below that of the interior of the Moore tube when in use, so that ozone cannot be a stable end product, nor can its formation cause the reduced pressure.

This leaves only the uniting of nitrogen and oxygen to form one of the oxides of nitrogen as the probable cause of the phenomena. The formation of NO and of N_2O_5 as end products would not result in reduced pressure, while that of N_2O, NO_2 or of N_2O_3 would. Of these, NO_2 is the more probable end product, but this investigation must, of course, verify.

It is true that solid brownish-colored deposits are frequently formed in the body of the tube; but it is highly improbable that they are the products of reactions causing the observed gaseous contraction, for they are by no means invariably formed after prolonged use, and may, indeed, appear, either very soon after installation or not at all. They are, in all probability, due, therefore, to impurities or variations in the composition of the terminals or of the glass tubing.

It seems certain, therefore, that the formation of one or more of these oxides of nitrogen is the cause of the reduced pressure of the tube. Apparently, Mr. Moore has come to the same conclusion—it may be by investigation—for he has often spoken of his light as one which "burns air."

Now, numerous investigations on the fixation of atmospheric nitrogen have demonstrated that the formation of oxides of nitrogen are purely thermal effects. (See Prof. Guye, this journal, 1906, p. 136, and Foerster and Nernst, Ibid. p. 256). This being the case, the oxides of nitrogen will be formed in the tubes wherever there is sufficient heat development, and that is throughout the tube, since eighty-five per cent. of the electrical energy put into the tube is converted into heat. Throughout its entire extent it becomes uniformly hot.

The heat development of the terminals is not appreciably greater than in the body of a tube, though bolometric measurements may show some slight difference. But this is certainly not considerable; so that in view of the far greater reacting volume of gas in the body of the tube it appears that the formation of oxides of nitrogen takes place in the Moore tube throughout its entire extent where it is accomplished by the emission light.

The chemical actions here involved may not necessarily be direct ones. Ozone or other unstable but active molecular complexes may be concerned in it, and the reactions may be reversible and have low reaction velocities, but the sum total result of electrical activity in the Moore tube is, apparently, the formation of a stable oxide of nitrogen accompanied by and intimately connected with the continuous emission of light rays.

This conclusion is important in that its verification will furnish a practical substantiation of the theory of the chemical nature of gaseous luminosity advanced by Prof. Armstrong and already cited in this article. And verification is not difficult; it includes two steps: First, identification of the substances formed in a tube and an investigation whether the concerned reaction velocities are greatly influenced by heat. Second, an observation of the effect of temperature variations in the conducting gases on the candlepower of the light which they emit, these temperature variations to be controlled by means external to the tube. If, for example, NO_2 is formed, and if the reactions producing it give rise to luminous effects, then cooling the tube to a very low temperature during its activity, e. g., by liquid air, would lower the candlepower, for the velocity of NO_2 formation is greatly retarded by reduced temperature (see Guye, Foerster and Nernst, loc. cit.).

The probable result of such an experiment is indicated by one cited by Prof. Armstrong. He states that Prof. Dewar, in an experiment before the Royal Institute, cooled a phosphorescent Crookes tube with liquid air and that its discharge at once ceased. Prof. Armstrong attributes this result to catalytic, rather than thermal effects. If cooling to a low temperature produces similar effects in the Moore tube, as from the close analogy it may be expected it will, the dependence of the luminosity of a mixture of conducting gases on the velocities of gaseous chemical reactions will have been proven. This could not before have been proven, because only a vacuum tube as extensive as the Moore tube could give reaction products in amounts which could be identified.

Experiments such as suggested, if they verify the theory outlined above, will also teach several things about the Moore tube and vacuum-tube lamps in general. The first of these is that in order to secure high-efficiency gaseous

light-emitting reactions must be employed which are exothermic or whose reaction velocities possess a relatively low temperature coefficient. That is, it must not be necessary to change much of the electrical energy into heat in order to maintain the high temperature for a rapid reaction velocity, as is necessary in the formation of oxides of nitrogen. Or if suitable reactions of this nature can not be found the necessary acceleration of reaction velocity must be secured by the use of catalytic agents.

The second conclusion to be drawn from the above theory—an inference, indeed, which is palpably evident from what is already known concerning the Moore tube—is that there is a limit to its life. Air is constantly admitted to the tube, enters into chemical reaction therein, and the reaction products remain in the tube. If gaseous they will gradually accumulate therefore, and ultimately extinguish the light by displacement of the active gases; even if they were solid they would coat the interior of the tube and make the light very inefficient. It is to be expected that the Moore tube will occasionally need repair, therefore, though the contrary seems to have been stated.

Advantages and Defects of the Moore Vacuum Tube Light.

Mr. Moore claims for his light a high efficiency, good actinic value, low intrinsic brilliancy, safety, perfect illumination without shadows and a very long life, indeed, that it will last for years without repair. The efficiency of the tube has recently been the subject of careful photometric tests by the New York Electrical Testing Laboratories, which showed that the average luces per unit energy were 20.0 for the Moore, 11.2 for the Nernst, and 3.6 for the carbon-filament incandescent lights, which is equal to .65, 1.1 and 3.5 watts per candle power, respectively. This efficiency is for the rose-red light only. In tubes emitting white light the efficiency is stated to be only about half the above, that is, 1.5 watts per candle power. This is not as high an efficiency, therefore, as is obtained with the metallic-filament incandescent lamps now being introduced.

Mr. Moore at the present time rarely installs tubes giving a white light, probably because of their lower efficiency and unreliability; it is necessary to introduce other substances, and the tube conditions favorable to a long life or even satisfactory service are not yet thoroughly understood. The white light only is suitable for general use, of course, but the rose-red tint is satisfactory for exterior lighting and in rooms where proper color values are not essential.

The principal advantage of the vacuum tube is its low intrinsic brilliancy. Its light is but 12-candle power per linear foot. It has no extremely bright portion common to nearly every other form of artificial light, which strain the eyes whenever they are in the angle of vision. This evil is now being lessened somewhat by the general use of frosted globes or shades, but even these do not bring these other forms down to as low an intrinsic brilliancy as that of the Moore tube.

The perfect illumination without shadows, that is, from every angle of the room, which has been claimed as an exclusive advantage of the Moore tube, is equally well secured by the use of small units like low candle-power incandescent lamps suitably placed entirely around the sides of the room or on the ceiling at intervals of a foot or so. This method of installation produces the freedom from shadows quite as well as does the Moore tube.

The tubes are difficult to repair, and leave the room entirely without lighting facilities for a long time in case of a failure or accident to any part of the system. This fact, the high initial cost, and its want of what may be termed flexibility, that is, the impossibility of turning off or on at will a part of the tube illuminating any desired portion of the room, will militate against the rapid adoption of the Moore lamp for general illuminating purposes.

STARTING ARRANGEMENTS FOR GAS ENGINES.

For gas engines of 100 brake horsepower and upwards, the starting arrangements should be most carefully considered if a proper degree of certainty in starting is to be secured. In such sizes there are two chief methods employed, viz., where an initial charge of explosive mixture is pumped into the cylinder and then ignited to obtain the first impulse, and the alternative to this is to provide a supply of compressed air for putting the engine in motion, after which it automatically draws in the first charge in the usual way. In both cases it is customary to fit either a friction clutch or a fast and loose pulley to the main drive from the engine, so that it may start free from external resistance. In view of sizes of the belts in-involved, which are unwieldy for shifting from fast to loose pulleys, and of the frequent application of rope drives, friction clutches are being increasingly employed, and a word of warning in respect of them will not be out of place. There are good clutches and bad clutches, and of the latter it may be said that there is no appliance which will cause more worry and trouble than a bad clutch. It is almost superfluous to add, therefore, that only the best clutch should be considered for the purpose and in ordering, purchasers should state clearly for what purpose the clutch is intended, and that it must be amply strong for the work. On the whole, we would be inclined to advocate the invariable adoption of compressed air as a starting medium for engines of 150 horsepower and over, but the use of petrol as a means of supplying a powerful gas to the engine for starting purposes is also being increasingly employed with exceedingly good results.

POSTAL COMMISSION REPORT.

The American Weekly Publishers' Association, through its worthy president, W. D. Boyce of Chicago, sends a report on the postal commission's inquiry regarding second-class mail matter. While no drastic changes were made by the last Congress, yet a new postal bill is to be brought before the Sixtieth Congress that threatens to impose burdensome restrictions on the publisher that cannot but be shown by an increased subscription price. The association is working to prevent this and in the words of Mr. Boyce, "to work constantly for lower rates, fairer and better postal conditions, and a 'free press,' untrammelled by bureaucratic or commission ruling, but supported by the dignity and justice of court decisions." Following is Mr. Boyce's creed:

"Do not keep the alabaster boxes of your love and tenderness sealed up until your friends are dead. Fill their lives with sweetness. Speak approving, cheering words while their ears can hear them, and while their hearts can be thrilled and made happier by them; the kind things you mean to say when they are gone, say before they go. The flowers you mean to send for their coffins, send to brighten and sweeten their homes before they leave them.

"If my friends have alabaster boxes laid away, full of fragrant perfumes of sympathy and affection, which they intended to break over my dead body, I would rather they would bring them out in my weary and troubled hours, and open them, that I may be refreshed and cheered by them while I need them. I would rather have a plain coffin without a flower, a funeral without an eulogy, than a life without the sweetness of love and sympathy.

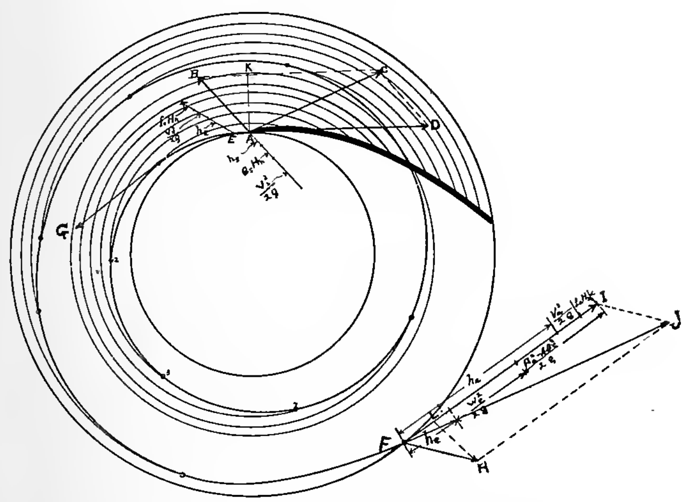
"Let us learn to anoint our friends beforehand for their burial. Post-mortem kindness does not cheer the troubled spirit. Flowers on the coffin cast no fragrance backward over life's weary way."

THE CENTRIFUGAL PUMP.

By E. N. Percy.

The lifting power of a centrifugal pump is proportional to the difference between its inside and outside diameter. If the inside and outside diameters are Da and De respectively, and Ua the tangential velocity of the inner diameter and Ue the tangential velocity of the outer diameter, the pressure or head due to the work of the pump will be $\frac{Ua^2 - Ue^2}{2g}$ and if Ut = angular velocity.

$$\frac{\left(\frac{Da}{2}\right)^2 - \left(\frac{De}{2}\right)^2}{2g} W = \frac{Ua^2 - Ue^2}{2g}$$



SPIRAL WITH ENTRANCE AND EXIT DIAGRAM

Either member, multiplied by the efficiency, gives the pressure to be expected. Either member, multiplied by weight of water lifted, gives the power used by the pump; and either member is independent of power used, or quantity of water, though when one of the latter is introduced in the equation, the other is, naturally, determined.

The losses which have already been considered in a preceding article, under the heads of those due to friction, shock, whirls, and escape around wheel crack, can not be separated nor determined, except collectively, by actual trial. Analysis, already made, has shown how to avoid most of these losses so far as is possible. Further avoidance can be accomplished by a careful, and mathematically correct design of guide blades, wheel blades, and port areas.

We have already shown that the radial velocity of the water was dependent upon the quantity alone, the tangential velocity upon the angular velocity, and, therefore, the tangential velocities of entrance and discharge are proportional to the runner velocity and blade shape, from which we have the following three rules, governing the centrifugal pump:

1st. The direction of the water, relative to the runner, in the exit diagram, can be changed only by the shape of the blades.

2d. The tangential component of the exit diagram can be changed in length only by variations in speed or diameter of runner.

3d. The radial component of the exit and entrance diagrams is unchangeable and determines the amount of the relative velocity, whatever the direction of the latter may be. The radial component can be varied by changes in port area only.

A theoretically high efficiency, for a given set of conditions, is very different from a fairly good efficiency over a wide range of conditions, which is the usual requirement of an ordinary commercial pump. Furthermore, a pump is better without guide vanes than with vanes suited to conditions other than for which the pump is designed. To these facts much discussion as to the merits of guide apparatus is due. No doubt, runners and guide blades can be made that will cover a wide range of conditions fairly well.

Having before discussed the entrance diagram and entrance guide apparatus, we now proceed to the development of the suction tip of the blade.

Taking Fig. 1, the circle A, on which the entrance diagram has been constructed, and divide it into twice as many spaces as there are to be blades. On one of the points, C, midway between two blades, construct the entrance diagram according to the data decided upon. From Ue, at C, project a line into the circle A, at right angles to Ue. Tangent to this line, from center of A, draw a circle B. This will be the circle of evolution, from which the blades are to be con-

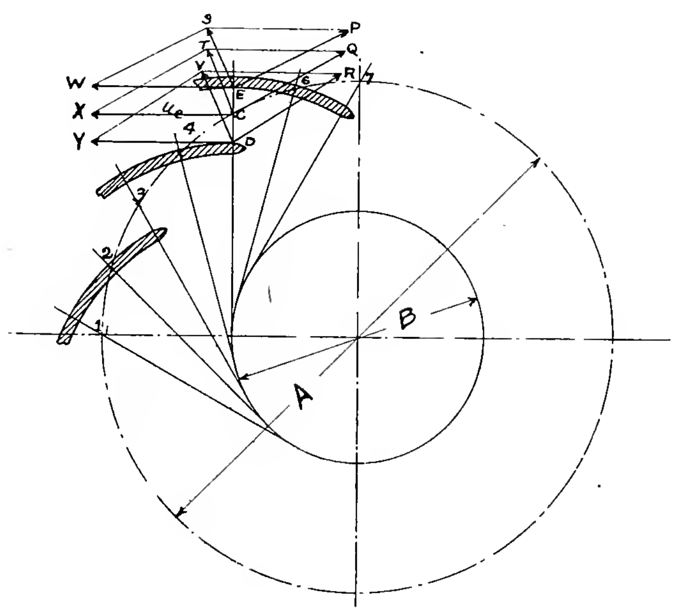


FIG. 1.

structed with non-contracting entrance channels and non-shock entrance.

From the points 1, 2, 3, 4, C, 6, 7, draw tangents to circle B. Construct the curve of each blade tip as an involute, formed by these tangents winding about the circle B, making them long enough that the entrance E-D is perpendicular to the relative streaming of the water; i. e., the tip of each blade should reach the tangent perpendicular to the line of flow and extend at least as far back as the next tangent, and some fractions of an inch more, before joining the belly of the blade, the construction of which will shortly be treated.

If we lay off entrance diagrams at E and D, we find that the three tangential velocities, P-Q-R, are, of course, different in size and direction for obvious reasons. As X, Y and W are parallel and equal by assumption and necessity, S, T and V must have different values and directions. Therefore, at plane E-C-D will occur shock losses and current friction losses, which, though slight, can be reduced by making circle B as large as possible, remembering that this will cause other losses due to too straight a blade belly, to be considered later; also making suction guide apparatus absolutely necessary, because of the extreme angle of S, T and V, and necessitate a wider runner for the same flow of water.

Added to the diagram shock losses are the shocks due to reduction of port area, due to thickness of blades, fully analyzed in a previous chapter.

Fig. 2. The exit tips of blades are treated in a similar manner. A circle, from which the diameter of the runner has been calculated, is drawn, and the exit diagram BMEH

constructed. At right angles to BM the tangent M2 is drawn and the circle J constructed. Each tangent cuts at right

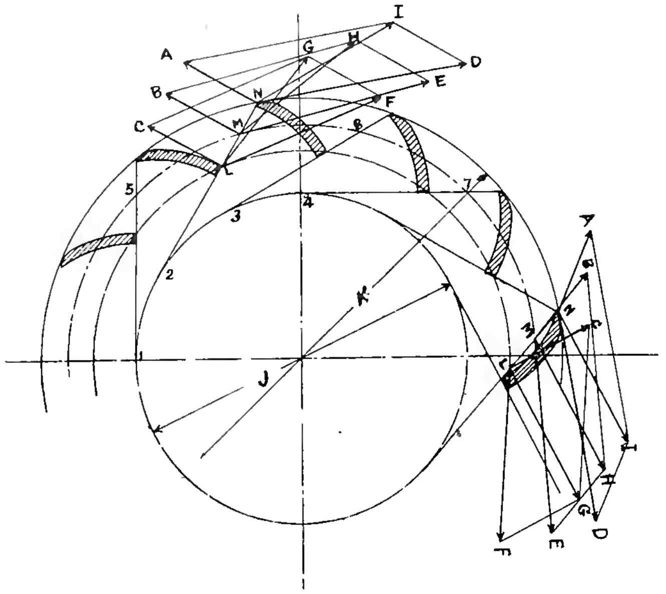


FIG. 2.

angles, the beginning and end of the tip of each blade, and lies in the plane representing the exit area of cross section for the stream. In meeting this condition we have, at last, arrived at the method of determining the number of blades necessary for a pump. Geometric proofs and trigonometric expressions of this graphical work can easily be deduced by simple analysis, but are not necessary to the design of the pump, if the graphical work is carefully done.

As D, E and F are obviously different in direction and value, and A, B and C all similar in direction and value; G, H and I are very different in direction and value and represent shock losses in the absolute exit currents.

When G, H and I are equal and parallel, the plane N M, L is to be taken on a tangent to the other side of circle J. One has then a picture of parallel discharge and the new

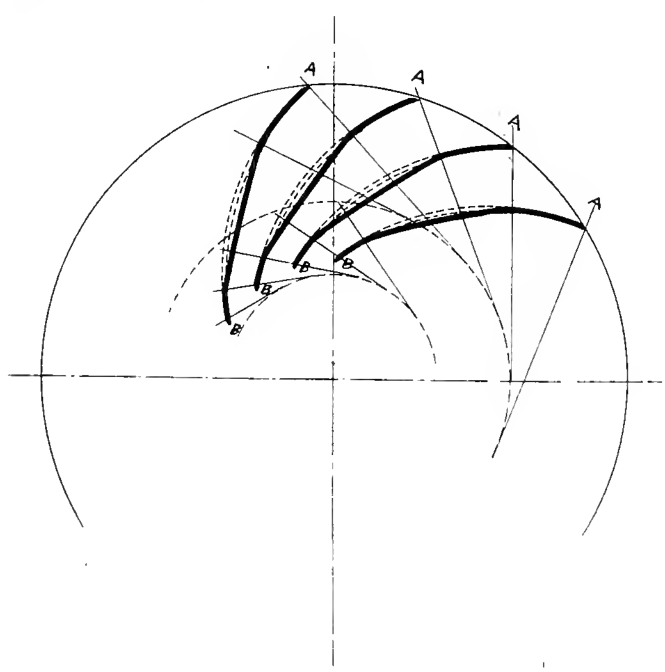


FIG. 3.

positions of A, B and C represent the changing directions of the water, as it passes over the blade curves. From these two diagrams we deduce that, as the blades are the same in both cases, the losses due to shock are only apparent, as all water particles have the absolute direction NI, when exiting from circle K.

Having now established the evolution of both tips and the number of blades, we will take up the development of water channel way, and belly of blade. See Fig. 3.

Having established the shape of the tips, A-A-A and B-B-B, it only remains to place them and connect by arcs (shown dotted). It will be noticed that if the blade follows the curve of the arc, a minimum cross section is offered to

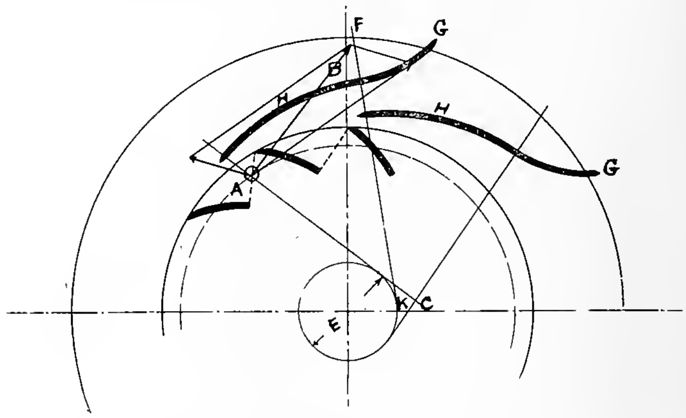


FIG. 4.

the stream, flowing perpendicular to the tangents; hence the blade should be flattened, as shown in an exaggerated degree, thus giving a maximum sectional area of port, that coincides with the sectional area of the stream in direction. The flat part should be evolved as two involutes, developed and averaged from tangents A and B, and with the developing tangent always perpendicular to the blade, because it is, by original assumption, perpendicular to stream lines.

The guide apparatus is laid off as follows: After choosing the number of guide vanes, usually about twenty-five per cent less than the number of wheel blades, lay off the exit diagram on the circle representing the aforesaid theoretical diameter of the runner A.

The water issues from the runner with an absolute velocity and direction B. At right angles to B, from point O, project OC in both directions. Draw circle E tangent to C.

With tangent C and circle E construct blade H as an involute to line FK, from which line the next blade begins, and the space between the blades widens out, gradually changing the velocity of the water to pressure.

The beginning of the guide vane must be at an appreciable distance from the runner for reasons set forth in a previous chapter. We now have a guide vane which receives the water, without shock, in the direction B, and guides it gradually to a radial direction and delivers it at a lower velocity and higher pressure to the casing chamber, the tangents from the controlling circle E being, as usual, perpendicular to port and stream lines.

It would be well to lay out the diagrams for various speeds of runner, showing shock effect of guide vanes. While it has never been done, it would be worth while to make a pump with movable guide vanes, so that they could be suited to various speeds, similar to the control of a water turbine; or the port area of the runner could be varied by having a telescopic wheel, similar to the control used in some of the older types of turbines.

Pumps without guide apparatus, including many commercial pumps, are made more economical by bringing the resultant velocities to as near as possible in direction to the tangential direction, and using a spiral casing. This is accomplished by slanting the blade somewhat forward of the usual positions, and increasing the port area of runner by leaving sides parallel, or nearly so, and the relative velocity is thus partly converted into pressure in the runner itself.

The casing for single pumps should have a spiral form

for a tangential discharge. It is necessary to furnish sufficient stream area at all points. Multi-stage pumps need circular casings, except on the last stage, and here also if with discharge from center, but a circular casing should never be combined with a tangential discharge for the simple reason that half of the water has to reverse its path immediately upon exit from the pump runner, or guide vanes, causing a large shock loss.

This has not been intended as an exhaustive analysis of the centrifugal pump, but merely the merest outline of the principles of design. Later will be given the different systems and types of multi-staging and high duty pumps.

LONG-DISTANCE DIRECT-CURRENT TRANSMISSION.

According to a writer in "Cassier's Magazine," there are 18 plants in successful operation in Europe employing the continuous-current varying-voltage system devised by M. Rene Thury. These plants aggregate 18,000 horsepower, the current varying from 40 to 250 amperes and the voltages from 1,600 to 60,000, the latter tension being used in the Moutiers-Lyons transmission which is over a distance of 112 miles.

The special advantages claimed for the continuous current over the alternating system are as follows:

First—The economy in transmission-line material and switchboards. Recent data show that on a line 95 miles long, the saving in transmission copper, poles, insulators, lightning arresters, etc., was estimated to exceed 50 per cent, where the direct-current voltage was 150,000 (grounded neutral) and the alternating-current, three-phase voltage 60,000, the line efficiency being 95 per cent approximately for the continuous current and 91 per cent for the alternating current, calculated values on the same comparative basis.

Second—The switching arrangements consist of one revolving switch placed on a post mounting the apparatus, and one of these is required for each group of generators, and in addition for the whole station only one other main station switch. This is claimed to lead to extreme simplicity in operation and some economy and saving in the number of operators.

Third—Freedom from lightning troubles is claimed, and it is pointed out that this is obtained by the use of a large inductance at each end of the line, the usual horn arresters and resistance with spark gaps for atmospheric discharge, while inside of all this a large condenser is placed, having the effect of absorbing any high peak of voltage which may pass the other somewhat standard devices.

Fourth—Freedom from mutual induction troubles is also obtained, static or capacity discharge considerably reduced, the distance apart of the wires becoming solely a question of brush discharge.

With the continuous current it is possible to reduce the potential to earth 50 per cent by grounding the middle point of the generating system, the units of which are connected in series; this makes it possible to operate at voltages up to 200,000.

It is now proposed to transmit 80,000 horsepower from the Rhone river to Paris—a distance of 250 miles—using a voltage of 120,000.

LOCATION NOTICE.

The Armstrong-Kreling Machinery Company, dealers in high-grade power plant equipment, have established offices at 88 Second Street, San Francisco, Cal.

APPLICATIONS OF THE FAN BLOWER.

The advent of electrical means of driving very much simplified the application of the fan blower. An electrically driven fan may now be placed at the most convenient point without extended systems of piping and with minimum loss through friction in pipes. Marine installations have called for special designs, in many of which a fan is arranged to be suspended from the deck above and driven by direct-connected motor attached to the side plate. For local or temporary application nothing can exceed the convenience of the motor-driven fan blower, which may be used for the ventilation of tunnels, excavations and the like. It is distinctly portable, renders ventilation positive at the most critical points, and avoids long piping connections. On shipboard portable electric blowers fitted with flexible pipe connections are employed for temporary ventilation of close spaces in the hold.

In modern installations the production and distribution of illuminating gas calls for gas blowers and exhausters, which blow the generators and transport the gas through long distances or from holder to holder. With this arrangement the works may be located at the most convenient point outside the city limits and the gas forced through relatively small pipes under considerable pressure to all parts of the city. Local boosting of pressure may be very simply provided by small blowers. This method of increasing the pressure is almost invaluable in localities where the consumption has outgrown the capacity of the pipes.

In every industry producing relatively light particles of refuse material, such as shavings, sawdust, lint, dust from polishing and grinding wheels, tumbling barrels and the like, the equipment is not complete without an exhaust fan and dust collector, by means of which the air is utilized as a medium for conveying the fine particles away from the source of production and quietly depositing them at a distant and convenient point. The modern buffing and polishing room, the foundry snagging room, the sand blast apartment, are all rendered healthy with a clear atmosphere by the introduction of the fan. Not only does such an arrangement prove effective in the matter of health and cleanliness, but it is important as a factor in reducing the cost of manual labor which would otherwise be required for the removal of the material. This is particularly true in the case of systems primarily installed for the conveyance of materials. Such, for instance, is an installation of fan, piping and suitable switches for transporting cotton, wool, rags and the like. The fan wheel is of special construction to prevent clogging and the system is so arranged that, for instance, wet wool may be passed from washers to dryers, and from dryers to cards, or cotton may be taken from the pickers, transported to the dye house, thence to the dry room and back to the pickers or to the card room. The fan serves to open up, clean and dry the material as it passes, and an expensive system of trucking is eliminated. No modern cotton gin is complete without a fan which draws the cotton direct from the wagon, and continues the process through the gin to the storage bins. Pulp chips in the sulphite mill, tan-bark, brewery grain, coffee, coke breeze and like materials are economically handled by the same process.

The susceptibility of any material to movement under these conditions depends upon the relation of its weight to its superficial area. The open newspaper is among the first to go flying in the air; it better resists the wind when rolled in a wad, and still better withstands such action when compressed into a hard ball. A rocky ledge remains immovable in the wildest hurricane, but the gentlest zephyr will waft it away if ground to impalpable powder.

The pneumatic separator and collector successfully applies the principles thus taught by nature. In such a system a current of air set in motion by an exhaust fan is the vehicle for conveying the fine particles; intensifying the current by restricting the area of passage enables it to pick up the large pieces

Electrical Construction for the Architect

ELECTRICAL FIRES.

An analysis of the report of the Electrical Bureau of the National Board of Fire Underwriters covering electrical fires from January 10 to April 10 of this year shows that there were 141 fires due to defective installation or to careless handling of electric apparatus. It seems that a brief account of the causes thereof would put the architect on his guard in making his specifications for similar installations.

Twenty-one fires were caused by high-tension lines falling on telephone and lighting circuits. Grounding of lighting and motor circuits was responsible for eighteen; short circuits on interior wiring caused thirty-two; electric flatirons four, and moving picture machines nine fires; fuses blowing caused six fires; electric motors, six fires; rheostats and controlling devices, seven fires, and lightning, nine fires. Incandescent and arc lamps have been responsible for five fires. There was one car heater fire and two fires resulting from use of electric bed warmers. All the fires summarized above were reported by inspectors. The losses so reported aggregate $2,748,285.44, but it should not be assumed that these figures represent the entire fire loss due to electrical causes. Many of these were due to careless handling of properly installed aparatus, but the following avoidable accounts illustrate mistakes in installation.

In once case a short circuit at untaped joints caused small damage. The lighting wires were not properly supported and the joints were neither soldered nor taped. No main switch was installed and cut-out was fused with copper wire. At a place where a branch tap was taken off the base wires were drawn together, forming a short circuit. In another case, ordinary Edison plug cut-outs were mounted on the under side of a board which was nailed to the joists supporting the first floor. These cut-outs were subject to moisture, dust and dirt which came through from the floor above, causing the current to arc across the backs of the cut-outs, igniting the board. The flames quickly spread to the floor above, communicating the fire to flimsy dress goods, which were stored there. In falling the burning embers set fire to a lot of empty packing boxes and waste paper in the basement. Loss $1200.

The motors operating fans in the dry room of a tannery were equipped with oil filled automatic starters. The handle of one of these starters was left in the starting position instead of being thrown over to the running position. The starters were so wired that the fuses only protected the motor and starter when the lever was in the running position, where it was supposed to be kept during operation. This scheme of wiring is resorted to in order to prevent blowing of the fuses every time the motor is started as at such times the lines carry heavy overload. The lever could be left in the wrong position through ignorance, carelessness or possibly purposely in order to reduce the speed of the motor. This would result in breaking down the coils of the starter or cause such heating that the oil would take fire. It is probable that the latter was the cause of the fire and the burning oil carried the fire to the surrounding woodwork. Loss was about $30,000.

A large eight-story office building was wired with weatherproof wire in wood moulding. This moulding was in part laid under flooring in cement. Distributing boards for each floor were located in a small closet near elevator shaft and exposed to water leaking down from janitor's sinks on the floors above. Wires were not bushed where they penetrated the closet walls. No main service switch was provided and fuse protection on each floor consisted of very old type open-link fuse-holders. None of these were blown after the fire. Distributing cut-outs were double pole main line plug type with jumpers of copper or very heavy fuse wire around the fuse plugs in nearly every case. Fire started on the fifth floor in the closet, due to the short circuiting of the weatherproof wires in moulding because of the water from floor above. Loss about $150,000.

Transformer was installed in small frame pent house on the roof of residence. The 1100-volt primary wires were carried through the walls of this pent house in ordinary porcelain tubes and without drip loops. Consequently, when it rained, the water followed the wire and grounded it to the walls. The swinging of the wires by the wind also caused them to be cut at the point where they entered the tubes. Sparking finally occurred and set fire to the frame walls. Loss not stated.

A fire was caused by electric light wires becoming grounded on a steel ceiling between the ceiling and the flooring above. Improperly made joints were found lying upon the upper surface of the metal ceiling. Joints were not soldered and only friction tape was used as a protection. The fire burned its way up through the floor above. Damage was slight.

A leakage occurred between the primary and secondary wires of a transformer on pole. The secondary was not grounded, but there were a number of beef coolers fed from it. These coolers were damp and afforded a poor insulation to ground. The wiring in the building where the fire occurred was in rather poor condition. A snap switch that had been mounted on a metal wainscot had one supporting screw not properly screwed home, but in contact with the live metal parts of the switch. One corner of the room was used for cutting salt pork and an accumulation of brine had so soaked the woodwork as to make it a good enough conductor sufficient to allow passage of sufficient current to carbonize and ignite it. Prompt discovery prevented loss.

A three-pole knife switch, controlling the lighting system of a store was too small to properly carry the total amount of current. In time it became overheated and ignited the insulation on the leads and caused a short circuit on the main feed wires, setting fire to the surrounding woodwork. Damage $1500.

Old-style cut-outs with link fuses were installed on the ceiling of the basement of a large department store just over a wrapping table. The contents were not in cabinet, as is required. For some reason the fuses blew and hot fuse metal, falling on some papers on the table beneath, set fire to same. Fire spread with resulting loss (reported) of $60,000.

A fire occurred in the blower room of a theater. This room was located in the front end of the building under the roof. A fuse in a 25-ampere open-link cut-out operated and ignited the insulation of the rubber covered wire at the block terminal. Cut-out was not enclosed in cabinet. The fire ran up the wire and ignited a bunch of paraffined bell wires which crossed the lighting circuit. From these wires the fire spread to wood partition. Loss $450.

An arc lamp was provided with an unapproved pendant snap switch hung on No. 19 lamp cord. The lamp happened to be out of order and an employee turned the current on and left it. The carrying capacity of the cord was entirely too small for the current and the cord heated and set fire to its insulation, which dropped into dry goods beneath. A total loss of about $60,000 resulted.

A cross between primary and secondary wires on overhead lines broke down the insulating joints in frame dwelling. The joints were of an unapproved type. Examination of the lines after the fire showed that the ground wire of the secondary was cut at the pole and therefore useless. Loss $2100.

APPROVED ELECTRICAL DEVICES.

This department from time to time will contain an illustrated description of all fittings approved by the Underwriters' National Electric Association.

SWITCH BOX.

"Marshall." A one-piece pressed-steel switch box for knob and tube work. Cat. No. 1467. Approved Jan. 14, 1907. Manufactured by

Marshall Electric Co., Boston, Mass.

"H. R." A drawn-steel box for knob and tube work. Approved Apr. 9, 1907. Manufactured by

The Holabird-Reynolds Electric Co., Los Angeles, Cal.

TRANSFORMERS.

Rollinson Bell Ringer for 110-120-V., A. C. circuits, supplying secondary voltages of 6, 6-12-18 and 6-16-24, respectively. Approved Feb. 4, 1907. When wiring to primary is installed in accordance with Class C, National Electric Code. Manufactured by

Mohawk Electric Co., Schenectady, N. Y.

WIRES, RUBBER-COVERED.

"Collyer." Approved Jan. 3, 1907. Manufactured by

The Collyer Insulated Wire Co., Pawtucket, R. I.

Approved Jan. 22, 1907. Manufactured by

Waterbury Co., New York, N. Y.

BLACKBURN GROUND CLAMP.

A metal strip secured to pipe by set screw. Approved March 19, 1907. Manufactured by

Geo. R. Blackberry, Cleveland, Ohio.

ROSETTES, FUSELESS.

Mebane, cleat type, Cat. No. "O. K." 74-71, 3 A., 250 V. Approved March 13, 1907. Manufactured by

J. A. Mebane Co., South Boston, Va.

SOCKETS, STANDARD.

G. E. Porcelain Shell, Edison type. Cat. Nos. 9393, 9395, 50799, 39947, 50896 and 34948. For use only in places where they will not be exposed to hard usage. Approved Feb. 13, 1907. Manufactured by

General Electric Co., Schenectady, N. Y.

CONDUIT, OUTLET BUSHINGS.

Sprague, panel and outlet box bushings, styles 6140 and 6120, for securing flexible conduit or armored cable at boxes. Conduit couplings, Cat. Nos. 5115 and 5320, for flexible conduit. Approved April 16, 1907. Manufactured by

The Sprague Electric Company, New York, N. Y.

RECEPTACLES, MINIATURE.

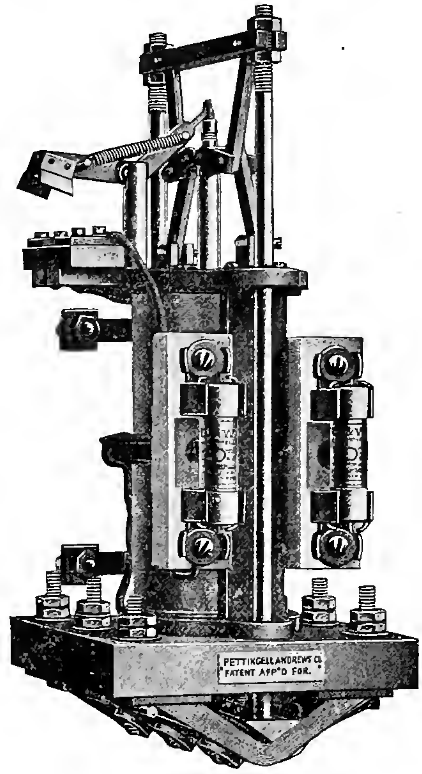
P. & S. candelabra sign receptacle, Nos. 878, ½ A., 125-V. Approved April 12, 1907. Manufactured by

Pass & Seymour, Solway, N. Y.

SIGN, ELECTRIC.

Mobile changeable; galvanized iron grids supported on porcelain blocks in galvanized iron frame; sliding Edison lamp socket. Approved April 16, 1907. Manufactured by

Federal Electric Co., Chicago, for Federal Sign System (Electric), New York.



SWITCHES, AUTOMATIC.

Pettingell-Andrews, for remote control, up to and including 200 A., D. C. 250 V., A. C. 440 V. One, two or three pole. Toggle mechanism, operating laminated copper switch blades by means of control circuits energizing magnets, with or without special iron box, control circuit to be wired throughout as for low potential systems. Approved April 16, 1907. Manufactured by

Pettingell-Andrews Co., Boston, Mass.

SWITCHES, KNIFE.

Davis type B, all capacities, 250 V. Approved April 16, 1907. Manufactured by

The Wesco Supply Co., St. Louis, Mo.

SOCKETS, STANDARD.

G. E. brass shell, key and keyless sockets, with or without shade holders, Edison type, key, Cat. Nos. 9386, 1317, 50760, 1318 and 99386; keyless, Cat. Nos. 9392, 1319, 50768, 1320 and 99382. T. H. types, key, Cat. Nos. 50713 and 50761, keyless, Cat. Nos. 50714 and 50769. Approved April 16, 1907. Manufactured by

General Electric Company, Schenectady, N. Y.

SOCKETS, WEATHERPROOF.

G. E. keyless, bracket, for 650 V. circuits, aluminum or brass shell. Cat. Nos. 32440-32443, inclusive. Approved April 16, 1907. Manufactured by

The General Electric Co., Schenectady, N. Y.

ATTACHMENT PLUGS, FUSED.

Perkins, 2A, 250 V., Edison and T. H. types. Cat. Nos. 3386 and 3387, with glass tube enclosed fuses. Approved April 24, 1907. Manufactured by

Perkins Electric Switch Mfg. Co., Bridgeport, Conn.

CABINETS.

C. H. Co. panelboard, wood cabinet, slate lined, with slate lined gutter. Approved April 26, 1907. Manufactured by

Crouse-Hinds Company, Syracuse, N. Y.

Spranley & Reed, a sheet steel cabinet for panelboards, holes in gutter provided with Federal clamp bushings, also pressed steel switch boxes or service entrance cabinets. Approved April 24, 1907. Manufactured by

Spranley & Reed, New Orleans, La.

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EASTERN AGENCIES
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Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," with which is incorporated "The Engineers', Architects' and Builders' News."
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VOL. XVIII MAY 25, 1907 No. 21

EDITORIAL.

THE ISOLATED PLANT AND THE CENTRAL STATION

The growth and development of the central electric light and power stations in all our great cities has been not only rapid but the extent of territory supplied from each plant has been increased, as well as the size of the individual stations. In the majority of cases, as a result of combining a number of independent companies, power and light are delivered to a single city from one or more plants. The general tendency has been to increase the field of the central stations, its electrical output being used for every class of service.

Isolated or individual electric plants were rapidly introduced soon after the direct-current system was an assured success, and the incandescent lamp and small motor were found to be practicable. Nor were all of these isolated plants small in size. Many large office buildings, hotels and manufacturing plants installed plants of large units, and in most cases the economy of these plants was satisfactory, taking into consideration the unfavorable conditions under which they were operated.

The low-load factor and comparatively small total output as compared with the maximum load, coupled with the high attendance charges per unit of output, resulted in many cases in the shutting down of these isolated plants, all the electrical power required being purchased from the central stations.

Central-station managers have consistently made every effort to shut down isolated plants, and in the majority of cases the cost of power and light has been greatly reduced by the owners of small individual plants making the change. However, it cannot be said that the service has been improved as a result of the change in every case, but the actual reduction in the total cost, including fuel attendance, and fixed charges in most cases, cannot be questioned.

The possibilities of the isolated plant to-day are greater than ever. Especially is this true where gas of the proper kind can be purchased by the isolated plant owner for fuel instead of coal or fuel oil. In many cases the adaptability of gas as a source of power in isolated plants and its small cost when purchased in large quantities, will result in reduced attendance charges, and smaller first cost of machinery. And when the conditions of service are not fully met from the central station, gas-power individual plants for electric lighting and general service will be a most acceptable substitute.

For office buildings and hotels 110-volt direct current is often required for small motors and other domestic uses, and the now common, 220-volt, three-wire, alternating-current lighting systems fall short of the electric service requirements. In such cases the isolated plant has many advantages, and can hold its own with the central station, providing the cost of gas for fuel is not too high, and the attendance charges for the electric plant can be kept down by combining the power and lighting plant with the heating and ventilating system.

A misleading conclusion, however, often results when isolated plant owners fail to realize that depreciation and fixed charges must be included in the cost of operation, in the same manner as fuel costs and attendance charges. Unless every proper charge is made against the complete isolated plant, ultimately it will be found that they are often a very expensive luxury.

CARMEN'S STRIKE IN SAN FRANCISCO

At this writing the strike of the Carmen's Union has been in progress less than three weeks. Tuesday, May 21st, the United Railroads operated 150 cars and carried 90,000 passengers. While the service is by no means restored to normal conditions, Mr. Calhoun has apparently demonstrated that the back of the strike is broken, and that a large number of citizens refuse to injure their own business by becoming a party to a controversy in which they are not directly concerned. Indirectly, of course, every citizen of San Francisco has the gravest concern in the interruption or obstruction of street car service.

The strike has vitally affected all lines of business, the retailers at first being the greatest sufferers; it has demoralized many industries and threatens to paralyze others.

It is obvious that Mr. Calhoun has not the small-

est intention of yielding to the Union's demands; and, indeed, during the last two weeks the rights or wrongs of the strikers have become an entirely secondary consideration. The vital question that now confronts San Francisco is the establishment of law and order, and the re-establishment of confidence. In the twenty days of the strike numerous cases of disgraceful lawlessness and disorder have been reported. The police, until animated by the firm declaration of Governor Gillett to keep order with State troops if the police continued to fail in their duty, proved themselves neither competent nor inclined to fulfill their sworn functions. The police force is the fruit of the present administration, and naturally the sympathy of individual patrolmen is with the strikers.

Both sides to the controversy, as is usual, express confidence as to its outcome. Mr. Mahon, president of the National Carmen's Union, in calm and measured terms expresses his convictions of ultimate victory, while Mr. Cornelius, president of the Local Union, whose style is somewhat hysterical, hurls each morning, through the columns of the press, all sorts of defiance at Patrick Calhoun, and, worse, all kinds of insults at those who choose to patronize the cars.

The management of the United Railroads claim they have closed their doors to the Carmen's Union forever. Mr. Calhoun, evidently, is a man of fearless strength and active ability. There will not be an hour's more interruption of street car service than Mr. Calhoun and his assistants can possibly help. It is said that an average of forty carmen are applying for their old positions every day, and it is further claimed that there is much dissatisfaction in the ranks of the Carmen's Union, owing to unsatisfying payment of pickets and the smallness of the relief granted the strikers.

In the meanwhile, the government of the city remains in chaotic condition. The nominal administration is still that by an indicted Mayor and of self-confessed criminal Supervisors. Such a situation is considered by many to be not only shameful but an unconstitutional farce. The real reins of the administration remain in the hands of District Attorney Langdon, and his assistant, Mr. F. J. Heney, who hold the whip of the penitentiary over the Mayor and Supervisors and can drive them to order.

As is always the case, there are two sides to every controversy. Fully seventy-five per cent., and we do not consider this an extravagant statement, of the Union men are as closely allied to capital in their principles and judgment of right and wrong as any two interests that are dependent upon one another could be in our commercial world.

President Calhoun is in a most trying position before the people of San Francisco, as are also the carmen. One with charges of bribery and threats of indictment as is chronicled each day in the daily press, but yet manfully standing up as he has to carry out his duty to the City of San Francisco as he sees it, deserves at least our admiration. While, on the other hand, fully seventy-five per cent. of the carmen are fighting for a principle, regardless of how trivial the cause might have been.

We consider it the duty of every good citizen of San Francisco to suspend judgment in each of the cases, and await the outcome with patience.

TRADE CATALOGUES.

The Barriett Electric Mfg. Co. of Cincinnati, Ohio, send Bulletin No. 5, showing the construction of their type E motors and generators which are designed as first-class, direct-current machines for withstanding hard work and rough usage.

The Arnold Company, 181 La Salle Street, Chicago, Ill., send a bulletin describing the Elgin and Belvedere Electric Railway, of which construction they had charge.

Bulletin No. 4394B from the General Electric Company, Schenectady, N. Y., illustrates and describes Form P belt driven alternators, which comprise a new line which the General Electric Company is placing on the market to meet the demand for small alternators having good regulation, delivering their output at low temperatures and able to carry a load of mixed character.

Bulletin No. 4497 displays the mechanism of Security Snap Sockets, whose cap and shell are held together by three bayonet catches, doing away with screws.

Bulletin No. 4494 portrays Edison "Gem" high efficiency incandescent units with bowl Holophanes, which throw the light down and spread it out.

Constant current transformer panels for series arc and series incandescent lighting systems are detailed in Bulletin No. 4500.

Bulletin No. 1059 from Allis-Chalmers Company, Milwaukee, Wis., illustrates and describes Allis-Chalmers engine type generators for direct current, type "I." They are designed for general lighting and power service wherever machines suitable for direct connection to steam, gas or oil engines are desired.

PERSONAL

G. Stuart Whyte of the Macumber-Whyte Company of Chicago, has returned home after a short visit to the Coast.

J. B. Livingstone, heretofore auditor of the Oregon Water, Power and Railway Company, at Portland, Ore., has resigned to become associated with the Jersey Central Traction Company at Keyport, N. J.

Lewis E. Ashbaugh, Assoc. M. AM. Soc. C. E., announces his resignation as associate professor of civil engineering, Iowa State College, Ames, Iowa, and his engagement on development of water power as engineering assistant to Robert McF. Doble, consulting and supervising engineer, 22-23 Giddings building, Colorado Springs, Colo.

Mr. G. E. Decker, who has been constructive engineer for the Edison Electric Company at Kern River Plant No. 1, has accepted a position as electrical engineer for the Mt. Hood Railway and Power Company, which is being built to supply light and power to Portland and vicinity. He will leave for Portland on June 1st.

INDUSTRIAL

TEST OF A 500-KILOWATT STEAM TURBINE AND ALTERNATOR.

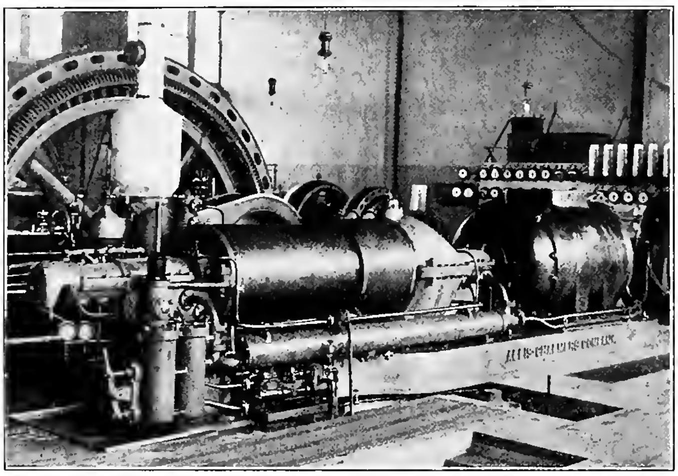
Some interesting tests of a steam turbine have been made by H. L. Rice, General Manager, and Mr. W. M. Willett, Electrical Engineer, of the Western United Gas & Electric Company, in that company's plant in Aurora, Ill. A description of these tests and the results obtained are given below.

Description of Unit.

The steam turbine is an Allis-Chalmers-Parsons standard horizontal turbine, rated at 500 kilowatts.

The generator is a standard Allis-Chalmers turbo-alternator, direct coupled to the above steam turbine, and rated at 500 kilowatts.

The condensing apparatus is of the standard turbo-jet type.



500 K. W., 3600 R. P. M. 60 CYCLE STEAM TURBINE AND ALTERNATOR AT WESTERN UNITED GAS AND ELECTRIC CO., AURORA, ILL.

The characteristics of the unit are as follows:

Rated capacity	500 Kilowatts
Speed	3,600 revolutions per minute
Frequency	60 cycles
Winding	2 phase
E. M. F.	2,200 volt
Current per phase (normal)	114 amperes
Construction of alternator	2 pole

The turbine was built to operate normally with steam pressure at 140 pounds per square inch gauge pressure at turbine throttle; dry saturated; and a vacuum of 28 inches of mercury, referred to 30-inch barometer at exhaust nozzle.

The unit is calculated to carry an overload of fifty per cent. when operating under the above steam conditions, and at one hundred per cent. power factor.

Conditions of Test.

The time during which the turbine could be spared for test was limited from midnight Saturday to midnight Sunday; it was, therefore, decided to run only two tests, viz., one at ten to fifteen per cent. overload, and one at three-quarter load.

As the turbine was provided with a jet condenser, the steam consumption had to be determined by weighing the feed water, and to correct this, it was necessary to make a boiler leakage test during the time available for test purposes.

To determine the amount of feed water used, two barrels, "A" and "B," were placed on a platform and connected with one another by a short horizontal pipe introduced into the sides of the barrels near their tops. A water supply pipe with valves was brought over these barrels for the purpose of filling them alternately. Each barrel was provided with a large plug cock in its bottom. The barrels were carefully calibrated, and when filled, so that the water would just enter the connecting pipe above mentioned, they were found to contain—"A," 413 lbs. and "B," 391¼ lbs. of water at 58 degrees F. As the feed water during the test was of a higher temperature, a correction has been made for the difference.

Under the platform, two receiving barrels were placed; into these the upper barrels emptied through the plug cocks mentioned. The lower barrels were connected with one another by a large horizontal pipe near their bottoms, and the suction pipe of the feed pump was brought into one of the barrels.

Two Stirling boilers, of 250 boiler horsepower each, supplied steam to the turbine during the test. Each of the six drums of the two boilers was provided with a gauge glass, and readings of the water levels in all six drums were taken at the commencement and end of the test, and also during the test. The blow-off pipes were blanked off, as were also the feed connections to the other two boilers in the station.

The auxiliary steam header for the feed pumps, etc., was disconnected from the main header, and the portion of the main header receiving steam from the other two boilers in the station was separated from the portion receiving steam from the two boilers which furnished steam to the turbine during the test, by means of a gate valve which was closed tightly during the test. In order that there might be no leakage of steam through this valve, the pressure on all boilers was maintained at about the same point throughout the test, so that both sides of the valve were under approximately the same pressure. From the header supplying the turbine a pipe ran to a 200-kilowatt Hamilton Corliss engine, which was shut down during the test, and the angle valve on the header shut off the pipe. Provision was made, near the engine throttle, to catch the drains from this pipe, but they were found insignificant and were disregarded.

The condensed steam from the steam header, as also from the steam separator near the turbine throttle, was discharged into barrels filled with a gauged quantity of cold water. As the water accumulated, it was taken out in buckets and weighed, and when the water in the barrel became sufficiently hot to vaporize, a weighed quantity of cold water was added. At the end of each test the water in the barrel was brought back to the original quantity.

The feed pump for supplying the calibrated feed water to the boilers was a Duplex outside packed plunger pump. The leakage from this pump was caught and returned to the lower feed water supply barrels. It was not necessary, therefore, to keep records of this leakage.

The steam gauges were checked by an inspector's test gauge which had been verified shortly before.

The quality of the steam during the test was determined by a throttling calorimeter, introduced into the steam pipe just below the separator at the turbine.

A water rheostat was used for providing load for the turbo-unit. Electrical readings were taken from the regular switchboard instruments in the station, and also from a set of calibrated instruments.

Between the overload and three-quarter load tests the boilers were tested for leakage. To determine this, all valves were closed after the boilers had been filled to marks on

the gauge glass, and the boilers kept under a steam pressure of 150 pounds per square inch for four hours. A calibrated quantity of water was then put into the boilers to bring the water level back to the original marks.

The following are the results of the tests:
Aurora, Ill.

First Test.

1. Average load ....570.8 kilowatts
2. Per cent of rated load..................114 per cent
3. Duration of test....................................4 hours
4. Steam pressure at turbine throttle...........143.3 gauge
5. Steam pressure at turbine inlet..............123.02 gauge
6. Vacuum turbine exhaust......................26.77 inches
7. Barometer ....29.5 inches
8. Vacuum at turbine referred to 30-inch barometer ....27.22 inches
9. Revolutions per minute..............................3600
10. Temperature of feed water...........................78.8
11. Total water used corrected for temperature....48,544 lbs.
12. Drips from steam header.........................318.75
13. Drips from steam separator........................68.25
14. Boiler leakage ....1927 lbs.
15. Moisture in steam by calorimeter...........5.12 per cent
16. Actual weight of water chargeable to turbine....43,878.23
17. Actual consumption of dry steam per kilowatt per hour 19.21

WESTERN UNITED GAS & ELECTRIC CO.
(Signed) H. L. RICE, General Manager.
(Signed) W. M. WILLETT, Electrical Engineer.

Second Test.

Aurora, Ill.

1. Average load ....385.8 kilowatt
2. Per cent of rated load......................77.5 per cent
3. Duration of test....................................4 hours
4. Steam pressure at turbine throttle...........142.4 gauge
5. Steam pressure at turbine inlet...............87.0 gauge
6. Vacuum turbine exhaust......................27.57 inches
7. Barometer ....29.45 inches
8. Vacuum at turbine referred to 30-inch barometer.... .... 28.08 inches
9. Revolutions per minute.............................3600
10. Total water used corrected for temperature...34,552 lbs.
11. Drips from steam heater.........................397 lbs.
12. Drips from separator............................91.5 lbs.
13. Temperature of feed water.............83.16 degrees F.
14. Boiler leakage ....1927 lbs.
15. Moisture in steam by calorimeter ....4.48 per cent
16. Actual weight of water chargeable to turbine...... .... 30,612.01 lbs
17. Actual consumption dry steam per kilowatt per hour 19.83

WESTERN UNITED GAS & ELECTRIC CO.
(Signed) H. L. RICE, General Manager.
(Signed) W. M. WILLETT, Electrical Engineer.

The Abner Doble Company, engineers of San Francisco, have appointed Mitsui & Co. to act as their sole agents in Japan and its territories, Korea, China and Manchuria, for the sale of Doble tangential water wheels and hydraulic apparatus. The industrial development that is now taking place in the Orient and the increasing demand for high grade water wheel machinery will make this co-operative arrangement an advantageous one for both parties.

REMOVAL NOTICE.

The Electric Appliance Company of San Francisco have moved from their temporary offices at 315 Main street and are now permanently established in their new and commodious offices and salesrooms at 726-730 Mission street. They have a full line of high grade electrical supplies, which are displayed to good advantage. These include Paranite wires and cables and "O. K." weatherproof line and house wires.

A WISCONSIN MUNICIPAL PLANT.

The City of Marshfield, Wisconsin, has finished the building for housing its new electric light and water works plant, and has started putting in the equipment. Concrete foundations have been prepared for supporting two Allis-Chalmers Reliance Belted Engines, which will be used to drive two Allis-Chalmers alternating-current generators, one of 225-kilowatt capacity, and the other of 100-kilowatt. The engines are 14x30-inch and 18x42-inch respectively, and the generators are 60-cycle, 3-phase machines. Of these two units the smaller will be used to carry the station's day load, leaving the larger portion of the lighting load for the larger machine. Three new 150-horsepower boilers of the horizontal tubular type, 72-inch by 18-foot, will generate steam for the operation of the station. In a sub-station, some distance away, the new pump will be installed seventeen feet below ground, by means of which water will be pumped into the stand pipe. The output from this new unit will be used to supplement the older pumping system, which is still to be kept in commission. The new pump will, however, supply enough water for all ordinary demands.

INDUSTRIAL.

The exposition at Jamestown will show, among other things, what the South has done and is doing in the line of industrial progress. The advance made by the "New South" during the last decade, in the development of her resources of water powers, forests, mineral wealth and agricultural products, has been at a rate which is almost beyond belief.

To the uninitiated the natural resources of the southern States in cotton, coal and iron may seem to be the strong features of Southern opportunity. It is true that they are the foundations on which have been built industries which are among the greatest wealth-creating factors in the world; but they represent only a portion of the South's advantages. It will be found, for example, that one-half of the standing timber of the United States below Mason and Dixon's line, and that the lumbering interests of the South are reaching a prominence which is the result of a steady growth during the past fifteen years. In 1880 the lumber products of the South were valued at $39,000,000. In 1900 this valuation was increased to $90,700,000, and in 1905 the value of lumber products of the South reached the sum of $250,000,000.

While the visible supply of timber in many sections of the North and West is steadily diminishing, southern saw mills are cutting great quantities of pine, and large tracts of cypress and swamp timber are being opened up. The timber supply has been sufficiently gauged to determine its limitations and the effort today is directed toward sawing all timber economically and so conserving the supply.

As typical of the class of improved saw mill machinery found necessary to accomplish this end, the Allis-Chalmers Company of Milwaukee has placed on exhibition, with other of its products, a band mill and saw mill carriage. The band mill was the latest of the principal modern developments in saw mill machinery, and the telescopic band mill is an important improvement in band sawing. The double cutting band mill adds more than 40 per cent to the capacity of the saw mills of America.

To furnish some idea of the execution of which these machines are capable it may be stated that a band mill, operating at one of the leading mills, recently made a new cutting record for the South. Out of 152 logs, consisting of assorted hardwood, ash, oak, gum, maple and elm, cut in nine and three-quarter hours, 98,521 feet of lumber were produced.

BOOKS RECEIVED.

"Self-Propelled Vehicles" is the title of the fifth edition of an "automobile educator" by James E. Homans, that tells not only how, but also why. While complete and technically accurate, it is also sufficiently simple to be understood by any one likely to run an automobile. The 592 pages contain 500 illustrations and diagrams, giving the essential details of construction and many important points of the successful operation of the various types of motor carriages driven by steam, gasoline and electricity. Apparently the presentation of subjects has been determined by consideration of the needs of the man behind the wheel. Theoretical matters—important almost wholly to designers and builders—are introduced only where good explanations positively require them, and at no point is the reader's mind burdened with padded material on experimental and obsolete construction. Considerable space is devoted to complete discussion of the theory, operation and management of the gasoline engine. All the accessory parts of an automobile, carburetters, igniters, transmission gears, are fully explained by typical examples. The author properly assumes that an adequate knowledge of the principles upon which these devices are constructed will enable the reader to understand variations for himself. Examples are given of all the more common machines, yet it is not a catalogue or recommendation for any one make. The book is sold at $2.00 by Theo. Audel & Co., 63 Fifth avenue, New York.

Proceedings of the American Institute of Electrical Engineers, Vol. XXVI, No. 4, contains a complete account of the dedication of the Engineers' Building, together with the addresses and responses given. This, together with the minutes and notices of meetings and a paper by J. S. Codman on "Rates of Charge for Electricity and Their Effect on Cost," complete Section 1. Section 2, papers, discussions and reports, include "Protection Against Lightning and the Multigap Lightning Arrester," by David B. Rushmore and D. Dubois; "New Principles in the Design of Lightning Arresters," by E. E. F. Creighton; "The Rowland Telegraphic System," by Louis M. Potts; "Notes on Hydroelectric Plant Organization and Operation," by Farley Osgood; "Relative Advantages of One Phase and Three-Phase Transformers," by John S. Peck; "Forced Oil and Forced Water Circulation for Cooling Oil-Insulated Transformers," by C. C. Chesney; "Enclosed Station Wiring," by F. O. Blackwell; "Potential Stresses as Affected by Overhead Grounded Conductors," by R. P. Jackson; "The Telephone Wire Plant," by Sergius P. Grace; "Light from Gaseous Conductors Within Glass Tubes—the Moore Light," by D. M. Moore.

PUBLICATIONS RECEIVED.

Volume 28, No. 10, of the Proceedings of the American Society of Mechanical Engineers contains the following papers to be read at the Indianapolis meeting, May 28-31, 1907: "Superheat and Furnace Relations," by R. P. Bolton; "Air Cooling of Automobile Engines," by John Wilkinson; "Materials for Automobiles," by Elwood Haynes; "Superheated Steam on Locomotives," H. H. Vaughan; "The Economy of the Long Kiln," C. E. Soper; "Railway Motor Car," B. D. Gray; "Analysis of Locomotive Test," Prof. S. A. Reeve; "The Ordnance Department as an Engineering Organization," General William Crozier; "Entropy Lines of Superheated Steam," Prof. A. M. Greene; "The Heating of Stone Houses," H. O. Lacount; "Special Auto Steel," T. J. Fay; "Materials for the Control of Superheated Steam," M. W. Kellogg; "Ball Bearings," Henry Hess.

EXAMINATION FOR ENGINEER.

The United States Civil Service Commission announces an examination on June 19, 1907, to secure eligibles from which to make certification to fill the following named vacancies as the result of examination in Branch 1, steam engineering, and vacancies as they may occur in the Indian service in the engineering positions indicated below. Engineer, qualified in acetylene and gasoline gas, $800 per annum, Carson, Nev. For this position it is desired to secure an engineer who has had experience in the use of acetylene and gasoline gas, which experience must be shown in the application. Engineer, qualified in gasoline gas lighting system, $720 per annum, Arapaho, Okla. For this position it is desired to secure an engineer who has had experience in the management of a gasoline gas lighting system, which experience must be shown in the application blank.

Applicants should at once apply either to the United States Civil Service Commission, Washington, D. C., or to the secretary of the Board of Examiners.

The United States Civil Service Commission announces an examination on June 19-20, 1907, to secure eligibles from which to make certification to fill the following-named vacancies in the position of clerk-draftsman in the offices of the Surveyors General of the Land Office service, at the places indicated, and similar vacancies as they may occur: One, $1400 per annum, San Francisco, Cal. Two, $4 per diem each, Phoenix, Ariz. One, $4 per diem, Helena, Mont. Two, $4 per diem each, Reno, Nev.

FULL ELECTRIC SERVICE ON THE NEW YORK CENTRAL.

Complete electric service over the zone extending between the Grand Central station and Highbridge on the main line was instituted on April 23, when, for the first time, the Twentieth Century, the Empire State Express, and other noted trains were hauled through the Park avenue tunnel by electric locomotives. For several months the local and suburban trains of the company have been under electric operation, part of them under the multiple-unit system, and the rest hauled by the new 95-ton locomotives. The change from electric to steam locomotives is made at Highbridge in four or five minutes; but the company expects ultimately to reduce this time to two minutes. The party of officials which went out to Highbridge was treated, incidentally, to a display of the great hauling power of the new equipment, when one of these locomotives picked up a disabled steam locomotive, with its freight train of fifty-six cars, and hauled it to the yard with comparative ease.

FAREWELL DINNER.

Mr. E. G. Dewald, until recently the San Francisco manager of the Platt Iron Works, was tendered a farewell dinner at Tait's Cafe on Thursday evening, May 16, by a number of his friends. Since coming to the Coast eight years ago, Mr. Dewald has done much to advance water-wheel design and construction and his absence will be keenly felt by the profession. The dinner was given as a mark of appreciation and thanks for his services and also served to welcome his successor, Mr. C. R. Newcomb, Jr., who has already earned the regard of the machinery men. The good fellowship at the table emphasized the spirit of co-operation and the determination to advance Coast power plants by those present.

NEWS NOTES

INCORPORATIONS.

Fresno, Cal.—The Coalinga Four Oil Company has filed articles of incorporation with a capital stock of $50,000.

Fresno, Cal.—The Fresno Mutual Electric Light Company has been incorporated with a capital stock of $50,000. The sum of $30,000 has been subscribed by Tong Duck, Sing Chung Lung, and five others.

San Luis Obispo, Cal.—The Premier Oil Company has been incorporated with a capital stock of $500,000, shares $1 each. The directors of the concern are Neil Cook, C. K. Bright, James Taylor, T. A. Norton and E. T. Ferguson.

Los Angeles, Cal.—The Wonder Electric Power and Water Company has been incorporated to develop power on two streams located in what are known as the Silver of Stillwat Mountains, twelve miles north of Wonder townsite.

San Francisco, Cal.—The San Francisco Railway and Power Company has been incorporated here with a capital stock of 1,000,000 shares, $100 each. Those behind the project are B. F. Clarke, F. C. Boeckmann, G. K. Ford, G. E. Bennett and J. R. Sloan.

Bakersfield, Cal.—The American Crude Oil Co. has filed articles of incorporation with $500,000 capital. The directors of the corporation are J. M. Danzinger, W. F. West, D. C. Wallace, M. H. Hannas and E. A. Randolph, all of Los Angeles, the principal place of business.

TRANSMISSION.

San Francisco, Cal.—The Sierra Power Company applied last week for a franchise to erect stations, power lines, etc., and to equip an electric plant in this city for the transmission of power from the Sierras and its distribution and sale for all industrial purposes.

Redding, Cal.—A three-days' battle of three rival electric companies before the Board of Supervisors was settled on May 14 by the adoption by the supervisors of an ordinance providing for the crossing of the lines of the different companies. A senior company, says the ordinance, must be given thirty days' notice by a junior company that the latter wants to cross. Within that time the senior company must raise its wires or the junior may stretch its wires above those of the other. The expense of elevating the wires must not exceed $350 in any instance and the junior company must pay this. The Northern California Power Company, the first company in the field, clings tenaciously to the point of having its wires on top.

Sacramento, Cal.—The property of the Northern Electric Company at 1020 Eighth Street will soon be converted into a baggage room and ticket office for the accommodation of passengers when the company has its interurban line running into Sacramento from Marysville, Chico and Oroville. The company is rushing work on its lines to this city and expects to be operating cars here about August 1. It has already laid the track from Nineteenth and B, where it enters the city, to Fifteenth and G Streets, where it will cross the tracks of the Sacramento Electric, Gas and Railway Company.

Carson, Nev.—The big power proposition being planned for Woodfords, Alpine County, Cal., by the California-Nevada Power Company is rapidly assuming definite shape, according to the statement of President F. G. Baum, who passed through this city on his way to Woodford, where he goes to close the deal for several large holdings of land needed by the company for its project.

ELECTRIC RAILWAYS.

Moscow, Ida.—It is expected that grading on the Spokane and Inland Railway will be completed between this city and Palouse by July 1.

Spokane, Wash.—Council will pass, May 14th, upon a new franchise sought by J. P. Graves of the Spokane Traction Company, covering a large number of new streets in the city.

Spokane, Wash.—The Panhandle Electric Railway and Power Company, capital $1,000,000, has been incorporated by Thomas W. Payne of Michigan; Amasa J. Smith, Harry W. Wallace, Spokane; Andrew Coolin of Idaho, and John R. Jones of Hillyard.

Monroe, Wash.—A franchise was introduced in the Council granting to the Seattle-Tacoma Power Company the right to come into Monroe. The franchise as it stands is a straight 50-year grant, without any restrictions or provisions. Attorney Norwood W. Brockett of Seattle, representing the power company, was present.

John P. Horgan, chief building inspector of San Francisco, has filed with the Board of Works the following table showing the volume of building operations in this city for one year from May 19, 1906, the date upon which the building bureau assumed control after the fire:

	Number.	Value.
Class A	36	$ 7,985,000
Class B	69	5,493,750
Class C	876	24,462,956
Frame	5,364	25,094,223
Alterations	2,483	5,539,138
Total	8,828	$68,575,067

The fees collected amounted to $104,637.50. Horgan says that the statement does not include any buildings erected as permanent or temporary previous to May 19, 1906, of which there were many and which are not of record in this bureau.

San Francisco.—At 10.17 o'clock Tuesday evening the residents on Church Street between Fifteenth and Sixteenth were awakened by a brilliant flash of light. Going to the windows they saw that an iron chain had been thrown over the trolley wire and the high-tension wire, sending up a bright flame. At the same time two men were seen running down Church Street, making good their escape after committing a felony which resulted in the burning out of the switchboards at the Turk and Fillmore substations and throwing the entire system of the United Railroads on the north of Market Street out of commission.

The company officials, headed by Chief Electrician Bivins, collected men to hurry repairs at the substation, and they completed the work in time to turn on the current again at 7 o'clock, when the first cars were run.

The act of vandalism was well planned to do the greatest amount of damage and was evidently perpetrated by some electrician who knew that the high-tension current from the San Francisco Gas and Electric Company's wires was taken on the United Railroads system at this point in Church Street. By throwing an iron chain over the two wires the current of 13,200 volts was short-circuited, and in the same instant the switchboard at the Turk and Fillmore streets substation burned out with a brilliant flash of light.

TELEPHONES.

Albany, Ore.—Home Telephone Company is constructing a trunk line from Corvallis to Peoria.

Butte, Mont.—Independent Telephone Company is erecting a new building on West Granite street, which is to be completed in six weeks.

Bakersfield, Cal.—The supervisors have granted the petition of J. V. Morley for permission to construct a telephone line along the Kern Island road.

Raymond, Wash.—Citizens favor granting a franchise to an independent telephone company, and are dissatisfied with the service rendered by the Pacific States Company.

Bellingham, Wash.—The Puget Sound Telephone Company asks franchises for lines over certain county roads, which will be heard by the County Commissioners June 5th.

Anacortes, Wash.—The city telephone office has moved to a new location in the Wells Building, and has an entire new outfit, switchboards, batteries, etc. Miss M. L. Childs, manager.

Ellensburg, Wash.—N. B. Watson, of the Pacific States T. & T. Co., requests a franchise of county commissioners for a line from this city over certain county roads. Board will act June 3d.

Tacoma, Wash.—The reported merger of all the independent telephone lines in the United States is said to be untrue, and given out to injure new independent telephone construction in the west.

Ferndale, Wash.—Council demanded 5 per cent of gross earnings, free water and option of buying plant of Ferndale Light, Water and Telephone Company before granting franchise, and the company will not commence business.

Ballard, Wash.—Council refused to permit Sunset Telephone Company to erect any more poles in the city on account of reported bad service. Ballard will soon become a part of Seattle, when the Independent Telephone Company can operate there.

Lakeport, Cal.—T. H. Gray, of San Francisco, representing the Pacific Telephone and Telegraph Company, has been in town looking over the telephone prospects with a view to running into Lakeport what is known as a toll line. This will probably be done. The company desires to improve the telephone service in Lake County.

Ely, Nev.—F. H. Harriman, manager of the Utah-Nevada Telephone Company, announces that his company will at once begin the construction of a line to run parallel to the Western Pacific from Salt Lake City to Ibapat, thence directly to Ely. The corporation is a branch of the Rocky Mountain Bell Telephone Company.

Fourteen lines will be utilized and the board for their accommodation has been ordered and will be put in place in the near future. The dispatcher's office at Pasco, Wash., and Trout Creek, Mont., will be connected. This will facilitate the work of dispatching trains at these points, where divisions have a terminus. The board will be in charge of three shifts of girls, each working eight hours.

The Northern Pacific Railway Company will install an independent private exchange in its general station in Spokane. The change will be made to concentrate the company's business and take it away from the Pacific States Telephone Company, thus assuring quicker service. The lines will connect the superintendent's office, the general agent's office, the yard offices, the local freight office, the depot ticket office and the apartments of the trainmaster, roadmaster and claim agents, the telegraph room and the round house.

Victoria, B. C.—The government has announced its intention to install wireless stations along the British Columbia seaboard. To enter into communication with these the Canadian Pacific Railway is placing instruments on its coasting vessels, the Princess May and the Princess Royal. The former vessel is now on the Victoria-Skagway run. The new Princess Royal is being rushed to completion at the yards of the Marine Railway Company and will be fitted with the wireless apparatus before being placed in commission next month. Wireless stations will be installed at Bamfield and Cape Luzon, Vancouver Island, and at Princess Rupert and other points on the mainland.

John T. Huetter will build the Home Telephone Company building in Spokane, where the contract for $60,000 was awarded a few days ago. This calls for the construction of the building proper, which must be completed by November 1. Excavation for the building was completed several weeks ago. The company has also put up a number of poles in the city and laid underground wires to be in readiness to put its plant in operation as soon as the exchange is completed. Cyrus Happy, vice-president of the Home Telephone Company of Spokane, declares there is no truth in the report that the corporation will be bought out or absorbed by the Pacific States Telephone Company. He added: "The ordinance covering the granting of a franchise to the company by the City Council provides that it cannot be sold to any corporation, company or individual. The franchise even prevents us from combining with any other company regarding rental and toll prices."

Chicago, Ill.—The development of the plan to cement seven thousand telephone companies into one gigantic organization is expected to follow the gathering in this city next month of one thousand managers and presidents of the interested companies. The men will come as delegates to the convention of the International Telephone Association to continue three days from July 4 at the Auditorium Hotel. The independent telephone associations of thirty states, with approximately $350,000,000 invested, are to send delegates to this convention to urge forward the movement to unite. Long-distance telephone lines throughout the country, giving unified service to more than 3,000,000 users of independent telephones, are contemplated. Ohio is leading the agitation with 300,000 independent telephones in use. Indiana is second with 200,000. The call for consolidation has come at the close of the most prosperous year in the history of the independent concerns.

Spokane, Wash.—State Auditor Bragaw announces that a much larger number of telephone and telegraph companies will pay taxes in Idaho this year than ever before. He has 53 companies on his list, a gain of more than 50 per cent over 1906. Under the Idaho law, the County Assessors are not charged with the duty of assessing or collecting taxes on the property of railroads, telegraph or telephone companies. This duty falls to the State Auditor or the State Board of Equalization. But with this delegation of authority, the law bequeaths no method of ferreting out the companies. He may send notices to the company listed in the office of the Secretary of the State, but unless they respond readily, or he goes out in person and hunts them down, he may not know whether they are real or fictitious organizations; whether they have one mile or 1000 miles of line in operation. Mr. Bragaw advised the County Assessors to look up such corporations, with the result given in the foregoing.

FINANCIAL.

San Francisco, Cal.—Captain Payson, president of the Spring Valley Water Company, has submitted to the Executive Committee of the Federated Water Committee a statement and figures concerning the standing of the company. This was in accordance with the request made at a previous meeting of the committee. At the session at which the report was made a committee composed of Charles Heuer, Jas. D. Phelan, and Walter McArthur, was appointed to investigate the statement and consult persons familiar with its technical features.

San Francisco, Cal.—The Union Oil Company will increase its dividends on May 20 from 75 cents to $1 a share a month, which is twelve per cent a year on the par value, $100. The Union Provident Company and the United Petroleum, both holding companies for the Union, have increased their payments from 75 cents to $1 and from $1.38 to $1.48 a month respectively. In his annual report President Stewart predicted that the dividends for 1907 would be more than double those of any previous year. With the second quarter they have increased thirty-three and one-third per cent.

Oakland, Cal.—Water rates for the fiscal year beginning July 1 were fixed last week by the City Council on the basis of the agreement reached by Councilman Pendleton, chairman of the Finance Committee, and Louis Titus, manager of the People's Water Company. This provides for a cut of ten per cent in present rates to general consumers, twenty per cent on city water, and forty per cent on fire hydrants. The agreement carries with it the understanding that there will be a further cut made the following year. Councilman Pendleton submitted a report showing in detail the figures upon which he had reached the cut and also the elements covering the San Pablo Creek supply.

Colfax, Cal.—Arthur L. Pease and James D. Stewart have started a suit in the Superior Court of this county against the South Yuba Water Company and the California Gas and Electric Corporation to get an injunction and $25,000 damages. Pease states that he owns a ditch, extending from Bear River to Gold Run, a distance of about fourteen miles, and that the South Yuba Water Company owns a ditch known as the Boardman Ditch in the same vicinity. The South Yuba ditch parallels that of Pease for a half mile and lies higher up on the hill. The former is in a dilapidated condition and recently broke and washed away a large portion of Pease's ditch. Pease claims that by reason of the neglect of the upper ditch it is liable to break away and destroy his at any time.

Redding, Cal.—The Northern Light and Power Company has brought suit in the Superior Court to condemn the rights of about twenty-five land-owners along Cow Creek in this county to about the 5000 inches of water in said creek, which the company desires to use for commercial purposes. The defendants are Henry Stacher, S. D. Wilcox, D. G. Hunt, J. M. Heryford, Frank Joseph, Nancy Toepfel, Chas. A. Hufford, J. R. Hunt, T. L. McBride, Etta Crews, Kahn & Abels, Nancy A. Fisher, H. M. Glover, Estate of J. F. Howard, J. K. Mears, Warren G. Atkins, Mrs. F. Arnold, C. F. Glover, John Bonds, Chas. Rippenberger, N. C. Brown, Chas. L. St. Vrain, L. A. Meeker, and J. W. McBride. The power company bases its claim on a water right of 5000 inches, filed on Old Cow Creek in 1904. The point of diversion is above the ranches of the twenty-five defendants. The company proposes to take thsi water from Old Cow Creek and lead it through ditches and flumes to its powerhouse site, where it will be turned into another stream. The company proposes to take this water from Old Cow Creek at a point below the ranches of the defendants. The water will be lost to them forever so far as irrigation purposes are concerned, and with the 5000 inches taken from the original stream there will not be enough left in the dry season, when the water is needed most, to begin to supply their needs. The company bases its right to take the water on the ground that it is a public service corporation. In other words, it has the same right to condemn riparian water rights that a railroad has to condemn a farmer's land for a right of way for its tracks. The power company asks the court to determine the amount of damage each defendant farmer will suffer. It proposes to pay what it takes. The suit is without parallel in the history of Shasta County. The farmers had supposed their riparian rights inalienable.

INCORPORATIONS.

Spokane, Wash.—The Standard Oil Company of Spokane has been incorporated for $25,000, with W. H. Broadus of Spokane, Dr. A. C. McKendry, and Dr. J. L. Hennifin of Butte as incorporators. Within three months the company intends to enlarge the plant and put in new machinery. The new improvement will cost at least $10,000.

Portales, New Mexico.—A company has been organized to put in a waterworks system. The capital stock is $15,000, a majority of which has been subscribed by local citizens. Hugh Lewis is president of the company, Seth Morrison secretary and treasurer, and Coe Howard manager. The president and manager will leave shortly for St. Louis to purchase the machinery for the plant and the pipe lines.

ILLUMINATION.

Lodi, Cal.—H. C. Keys, promoter of Lodi's proposed new gas plant, states that work on the new plant will commence within one month, or even sooner if it can be arranged.

Santa Barbara, Cal.—To meet growing demands the gas company will make extensive improvements this summer costing $12,000. The capacity of the plant will be increased. Harry Burkhart will have charge of the construction.

Goldfield, Nev.—William G. Beckley of Colton, Cal., wants to establish a crude oil gas plant in Goldfield and writes to the Chamber of Commerce all about it. He seeks capital here to help him out.

San Rafael, Cal.—Under direction of Manager Foster of the San Rafael Gas Company, an effort is being made to ascertain the wishes of the Mill Valley people in the matter of extending the gas-pipe line from San Rafael to that place.

OIL.

Oakland, Cal.—The Southern Pacific Company is erecting another big oil tank in the West Oakland yards, near the new roundhouse.

Bakersfield, Cal.—It is currently reported that the Fulton Oil Company has closed a contract with the new Sunset refinery, now being built in the Sunset fields, by which the refinery acquires all the output of the Fulton Company for the next five years. It is said that the price scale is graduated, running between thirty cents and forty cents, the highest price paid for local oil.

Bakersfield, Cal.—The Maricopa Oil Company of Sunset has recently closed a deal with the Gate City Oil Co., a newly formed corporation with Stockton capital, by which the south half of the holdings of the Maricopa are leased to the new company, which will use and market the oil itself. The land leased consists of twenty acres of the choicest land in the Sunset fields. As yet no development work has been done, but the new company will put a string of tools to work at once and it is expected that a good strike will follow soon.

FINANCIAL.

Antioch, Cal.—The Antioch Oil Company has declared an assessment of 1½ cents per share, delinquent June 1; sale day, June 15.

San Francisco, Cal.—The Berry Oil and Development Company has declared an assessment of $1 per share, delinquent May 29; sale day, June 15.

San Francisco, Cal.—The annual meeting of the stockholders of the Buena Vista Petroleum Company is to take place May 20 at 412 Front Street, in this city.

San Francisco, Cal.—An assessment of ten cents per share has been declared by the Record Oil Company. The assessment is delinquent June 15; sale day, July 8.

Porterville, Cal.—Assessment No. 7 of $10 per share has been declared by the Copa de Oro Water Company of this place. The assessment is delinquent June 1; sale day, July 1.

Lemoore, Cal.—An assessment of ten cents per share has been declared by the Lemoore Oil and Mining Company. The assessment will be delinquent May 28; sale day is June 18.

San Francisco, Cal.—A special meeting of the stockholders in the California and New York Oil Company's Consolidated is called for 10 a. m., June 1, at 1300 Golden Gate Avenue. The meeting is to be held for the consideration of the sale of the properties of the company and the proposition of consolidating properties of other companies.

San Francisco, Cal.—Judge Sewell has dissolved the restraining order secured by some stockholders of the Keystone Oil Company to prevent the sale of their stock to pay an assessment of $2.50 a share. It was stated in court that the oil company was in debt over $100,000, $87,000 of which is due A. B. Spreckels. The restraining order had been issued on the assertion that no due notice of the levying of the assessment had been given.

San Francisco, Cal.—The Geary Street Railway Company paid into the city treasury last week the sum of $1240.35 as five per cent of the gross receipts of the road during the month of April. The earnings of the road have nearly doubled as compared with the period previous to last year's disaster. In the last ten months the company has paid into the city treasury the sum of $12,243.90. The gross receipts of the road amounted to $244,878. The percentages received monthly were as follows: June 21 to July 31, 1906, $1172.11; August, $1493.84; September, $1397.45; October, $1207.54; November, $1149.65; December, $1230.47; January, 1907, $1115.41; February, $1045.55; March, $1182.53; April, $1240.35.

Santa Clara, Cal.—An indebtedness of $60,000 has been incurred by this town for municipal improvements. The amount is distributed as follows: $30,000 for the construction of a sewer system, in forty bonds of $750 each and bearing interest at the rate of 4½ per cent per annum; for the reconstruction and repair of the light and power works, $21,000, in forty bonds of $525 each bearing 4½ per cent interest; for repairing the two schoolhouses of the town, $9000, in forty bonds of $225 each and bearing 4½ per cent interest. An ordinance calling for bids on the improvements proposed has been passed by the Board of Trustees. May 23 is the last day on which the bids may be handed in.

WATER WORKS.

Coalinga, Cal.—Holmes Henshaw and associates have undertaken the piping of water from the artesian well, generally known as the McClurg well, to within a mile of the town. At present the well is flowing five hundred barrels per day. Two pumps will be installed, as well as storage tanks on hills adjacent to the well. A reservoir is planned for the future.

POWER AND LIGHT.

Kennewick, Wash.—Poles are now being erected for the installation of arc lights on Front and Second streets.

Seattle, Wash.—The Capitol Hill Improvement Association is circulating a petition for cluster street lamps, fed by underground wires.

Tacoma, Wash.—Merchants on C street have had ornamental cluster electric lamp posts set between Ninth and Thirteenth streets at their own expense.

Kalispell, Mont.—Plans are being prepared by the Flathead Valley Water Power Company for improvements to the Big Fork Electric Power and Light Company, to cost $50,000. L. W. Tingle, manager.

Evanston, Wyo.—The Evanston Electric Light Company is contemplating installing a 150-kilowatt direct current unit, Corliss engine and two 125-volt machines for operating an Edison three-wire system. George J. Mercer, manager.

Snohomish, Wash.—P. E. Hall proposes to lay gas mains from Everett to this place and supply this city with gas. He has purchased the necessary pipe and construction will commence as soon as the franchise is granted for the line by the County Commissioners.

Bellingham, Wash.—Articles of incorporation of the Northern Light Company were filed in the County Auditor's office. The capital stock is placed at $1,500,000. The incorporators are J. H. Ambrose, Fred E. Lees, W. H. Chase and E. M. Hawkins. The principal place of business will be in this city.

Oroville, Wash.—Two carloads of machinery have arrived for the Oroville electric light plant and its installation is under way. Among the equipment received are large transformers which will prevent a great waste of current in transmission from the plant to the point of its use. The plant is located at Similkameen Falls.

Roseburg, Ore.—A city election was held here to vote on amendments to the city charter to authorize the City Council whenever they may deem it necessary, or the people by initiative, to call a city election to vote bonds to install water and light systems at a cost not to exceed $250,000, also amending the charter so as to provide a better and more effective manner of street improvement. The proposed amendments were carried by a vote of about 10 to 1.

Nelson, B. C.—The absorption of the Cascade Power Company, with a capacity of 6000 horsepower, by the West Kootenay Power Company makes the latter the second largest power company in Canada. It has a total horsepower exceeding 30,000 and the plant's capacity may be doubled with available water power. The only competing plant is that of the city of Nelson, 1500 horsepower, which can be increased to 6000 easily, and which is designed to supply Nelson with light and power.

Seattle, Wash.—The Seattle Lighting Company has asked permission to lay gas mains on Dexter avenue, from Mercer street to Roy street; King street, from Thirteenth avenue South to Thirty-first avenue South; East Forty-fifth street, from Second avenue Northeast to Fifteenth avenue Northeast; Fourteenth avenue Northeast from East Fifty-sixth street to East Fifty-eighth street; and East Fortieth street, from Tenth avenue Northeast to Fi eenth avenue Northeast; also Thirteenth avenue South, from Judkins street, to Atlantic street, and Twenty-second avenue, from East Cherry street to East Terrace street.

ILLUMINATION.

Escondido, Cal.—At the last regular meeting of the City Council an application was presented by Wheaton & Foster for an electric light and power franchise.

Douglas, Ariz.—The franchise asked of the city by the Douglas Improvement Company for water, electric light, and telephone privileges has been defeated by popular vote, 281 to 69.

Yuma, Ariz.—Seth Hartley is here to start work on the gas plant and system for which he was given a franchise by this city in January. Z. T. Bell is the contractor and work will start in a short time.

San Francisco, Cal.—Captain B. F. Cheatham, constructing quartermaster, has advertised for bids for furnishing material and labor and installing a complete electric lighting system and furnishing electric current for Forts Baker and Berry. The work is to be done in accordance with plans and specifications on file at the quartermaster's office, 1086 North Point Street, San Francisco.

Oakland, Cal.—Councilman Ellsworth of this city has expressed considerable doubt of the utility of the electroliers that were installed recently along the principal business streets of Oakland. He has told the members of the Merchants' Exchange that because of the mechanical difficulties the light given off was not so great as it ought to be. He said that this fault may be overcome and an effort will be made to bring about a remedy.

Santa Cruz, Cal.—The Coast Counties Electric Light Company has sent its officials here on a tour of inspection to the works here. They have decided to add a new gas machine to the local equipment at the plant here, of which Van E. Britton is manager. Arrangements have been made to double the capacity of the high-pressure gas-distributing system. Arrangements were also made for the building of a six-inch suction pipe from the pleasure pier out into the bay to supply water for the power house and other beach buildings, to take the place of the eight-inch pipe formerly used.

Sacramento, Cal.—Professor C. L. Corey, head of the College of Mechanics at the University of California, was in this city last week as the guest of the committee appointed by the Board of Trustees to investigate the cost and maintenance of a municipal electric lighting plant. He went over the ground in the neighborhood of the city sump and garbage crematory and also visited several other sites which have been considered suitable for a city plant. No selection was made, Professor Corey stating that he would like to have time in which to make calculations and estimates. He would not set any amount as the cost of the proposed plant. When he does make his report to the committee, the latter will inform the Board of its decision. Several city officials, including Mayor Beard, City Engineer Randle, Superintendent of Streets Irvine and Trustees Carragher and Roder, consulted with the university man as to the advisability of raising bonds for the purpose. It has been suggested that the city issue ten-year bonds and have the plant erected by a private concern. The latter would have to take its remuneration in yearly installments which could be derived from the regular tax levy. Mayor Beard and the city officials who have talked over the scheme are enthusiastic and believe that it will be an easy matter to establish a municipal system.

TRANSPORTATION.

Los Angeles, Cal.—Work has commenced on the new electric line to be built by H. F. Huntington from Pasadena to Dolgeville, through Monticello and the Pallet ranch in the Ranchita Valley to Downey and thence to Signal Hill at Long Beach.

Santa Rosa, Cal.—The Sonoma & Lake County Electric Railway has petitioned for a franchise from the city of Cloverdale to be permitted to come into that city with its road. The work of construction is to begin at once and the road has purchased the Peter McKenna property on Railroad Avenue for a depot site. The road is to be standard gauge and will transport passengers, freight, mails, and express matter. It will operate cars of the most approved pattern, provided with safety fenders. The money for conducting the road has all been provided for, and it will run from Cloverdale, on the Northwestern Pacific Railroad, and tap the summer resorts and resources of Lake County.

San Francisco, Cal.—President Platt, of the Geary Street Railroad Company, has notified the Board of Supervisors that he would not run his cars under the union schedule. As a result, the temporary permit under which the road has been operating was taken from the company. President Platt held a meeting with his directors before the announcement, and it was decided that, while it would be possible to resume car service upon agreeing to pay the old employees the $3 and 8-hour wage scale demanded, it would be impossible under any other circumstances. The directors refuse to make this concession to the carmen, even in the face of losing their license to operate the line. There are $671,000 of the bonds of the Geary Street Company outstanding, which are held all over the world. On these bonds it will be impossible to realize more than one-third of the face value, according to A. D. Shepard, the secretary of the company. The bonds are a lien on the equipment, rolling stock, and property of the company, but without a license to run cars this property will be of little value and must be disposed of at a sacrifice. In its dealings with its employees the company has been most liberal. The back pay under the award of the board of arbitration was paid as far back as August 26, and the employees have never had any grievance which was not speedily adjusted until the recent strike.

OIL.

Visalia, Cal.—If the proposed pipe line is laid, it will probably go through the Devil's Den, so that that field will at last have an outlet if it can be made to produce. The only development now going on there is by Smith & Bryant, who have leased the lands of the Visalia companies and are down one thousand feet. The Avelna, a company controlled by the Balfour and Guthrie people of Coalinga, has seven thousand acres and drilled a number of very shallow holes during the early days of the oil boom, none of which went below seven hundred feet, and some showed small quantities of oil. No work has been done for several years and the company is just holding its lands. The Western Oil Company (Spreckels) is holding a large body of land, doing only its assessment work. Two or three rigs are reported going up in the Krevenhagen district. These are owned, it is said, by the Krevenhagen brothers, the land owners and ranchers from whom the field is named. They sold for $10 an acre lands around Coalinga in the early days and the property is now held at $1000 per acre.

ELECTRIC RAILWAYS.

Seattle, Wash.—The Seattle Electric Company has begun the construction of its line down Prefontaine place.

Tacoma, Wash.—The American-Hawaiian steamer California has arrived here with 60 carloads of steel rails for the Orting line of the T. R. and P. Co.

Lewiston, Ida.—J. H. Morrow, general manager of the Walla Walla-Columbia River Electric line, states his company will extend their line to this city.

Tacoma, Wash.—Miller & Bischu have been awarded the contract for the erection of a brick car house 103x113 feet, to be built by the Pacific Traction Company at South Sixty-fourth street and Union avenue. Plans by Frederick H. Heath.

Bellingham, Wash.—Jacob Furth of Seattle states that the interurban electric railway for which surveys are now being made in Whatcom and Skagit counties, with Bellingham as a center, is to be the nucleus of a system connecting Bellingham and Seattle.

Eugene, Ore.—A. Welch of Portland, who is to build the street railway line for the Willamette Valley Company, states that construction of same will commence at once, and material is now arriving. He is also negotiating for purchase of the city water plant.

Grass Valley, Cal.—It is believed here that work will be started soon from a point near Lime Kiln on the grading for the California Midland Electric Railroad. John Martin is expected to arrive shortly with a number of his associates, and it is believed that he will order a big camp to be established at Lime Kiln. Some time ago he purchased 200 tons of hay and ordered it held at that point.

San Francisco, Cal.—The Supervisors' Judiciary Committee has refused to accept the bond of the Presidio and Ferries Railway Company, in the sum of $50,000, to insure the reconstruction of the Union Street Cable road into an electric system. The bond had been approved by Mayor Schmitz, but the committee took the ground that it was not worth the paper upon which it was written, as it was not dated and did not bind the company in any way to complete the road in nine months, the time required by the ordinance. The bond was referred to the town attorney for an opinion as to its efficacy.

Clarkston, Wash.—J. H. Morrow of Waitsburg, Wash., general manager of the Walla Walla and Columbia River Electric line, states that it was the intention of his company to make a survey from Dayton to Clarkston the present summer and that if a satisfactory route could be secured the line would undoubtedly be built to this city. Mr. Morrow also stated that it was the intention of his company to effect a junction with the Spokane and Inland at some point on Snake River; that Clarkston is the natural point for this connection and if an entrance to this city on a satisfactory grade can be secured the connection will be made here in preference to any other.

Tacoma, Wash.—The first building of what will become an extensive system of car barns and shops is to be erected by the Pacific Traction Company at Union avenue and South Sixty-fourth street. The buildings will be of solid brick, one story high. It will be used as headquarters for

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the cars of the American Lake and city lines temporarily. The Pacific Traction Company is making plans for the most elaborate system of car barns and quarters for the men on the Pacific Coast. The sites for all the buildings have not been announced, but it is understood that the main buildings and headquarters of the company will be near the center of the city. The company is now laying double tracks on Pacific avenue, paralleling those of the Tacoma Railway and Power Company.

Prairie Development Company—Judge W. W. Wood has decided that the Prairie Development Company, financed by D. K. McDonald, R. A. Hutchinson, Mark F. Mendenhall and J. Grier Long, who are back of the Spokane-Pend d'Oreille Rapid Transit Company, are the owners of 1500 acres of land on the shores of Lake Pend d'Oreille in Idaho, east of Spokane, the verdict being against F. A. Blackwell, chairman of the board of the Spokane and Inland Empire Electric Railway Company, and the Liebergs, who sold the land for $41,000 to the company and after the first payment was made did not appear to collect the balance. Mr. Blackwell then paid $5000 more than the company did and agreed to protect the Liebergs from suit. The court has ordered the Liebergs to carry out their contract. Mr. Long gave out this statement: "Upon the termination of the suit, we will begin building our line from Spokane to the lake, 46 miles. We have been held back for about a year by this deal, but feel now that work can be started. We did not care to risk the money of our stockholders while the land was in litigation, nor did we care to run the road to develop property owned entirely by other people."

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San Francisco, Cal.—Henry J. Crocker, vice-president of the Graciosa Oil Company, has returned from a visit to the field, accompanied by a party of oil experts. Several of the wells which had been capped were opened up for their benefit. One of them recorded a flow of 6000 barrels per day. Well No. 7, which had just been completed, flowed at the rate of 2000 barrels per day. At the present time four wells are being drilled, two of which are nearly completed, and the material is on the ground for the construction of six additional rigs. Extensive improvements are also being made in the way of warehouses, cottages for employees, boarding houses, and officers' quarters. Deliveries of 3500 barrels per day are being made to the Associated Oil Company by pipe line to Gaviota, also 5000 barrels through the Coast Oil Transportation Company's new 8-inch pipe-line to Oilport, where it is loaded by the Associated Oil Company on its vessels, in addition to which daily shipments are made by pipe-line to Casmalia, on the line of the Southern Pacific, where the company maintains tanks and loading racks for car shipments going to Los Angeles and San Francisco Bay refineries. All these shipments are being made from a number of the line wells, the largest producers being capped.

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Underground Electrical Conduits
Pierson, Roeding & Co.

Vibrators
Pacific Electric Mfg. Co.
Holtzer-Cabot Elec. Co.

Valves
Moore & Co., Chas. C., Inc.
Standard Elec. Works

Water Wheels
Allis-Chalmers Co.
Abner Doble Co.
Pelton Water Wheel Co.
Moore, Chas. C. Co., Inc.
I. P. Morris Co.

Water Wheel Governors
Allis-Chalmers Co.
Pelton Water Wheel Co.
Pierson, Roeding & Co.

Wires and Cables
California Electrical Works
Century-Klein Electric Co.
Okonite Co., Ltd.
Nat. Conduit & Cable Co., The
Roebling's Sons Co., John A.
Simplex Electrical Co., The
Standard Electrical Works
Standard Undergrnd. Cable Co.
Tel. and Elec. Equipment Co.

Woodworking Machinery
Henshaw, Bulkley & Co.

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The Engineers', Architects' and Builders' News

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THE

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The Engineers', Architects' and Builders' News

VOLUME XVIII. SAN FRANCISCO, CAL., JUNE 1, 1907 No. 22

Kern River Station No. 1 of the Los Angeles Edison Electric Company

Probably the most interesting and complete hydro-electric plant on the Pacific Coast is the new installation of The Edison Electric Company, of Los Angeles, known as Kern River Station No. 1. This plant, which has just been put in operation, will develop sufficient power to treble the capacity of The Edison Electric Company, the full load output of this plant, 40,000 horsepower, being more than twice that of all of the other plants combined operated under the management of The Edison Electric Company. The plant is located almost at the head waters of the Kern River. The hydraulic development includes a water conduit more than 12 miles in length, which makes available an effective head of nearly 1,000 feet. The length of transmission to Los Angeles is 117 miles, and the pressure used is 75,000 volts. We are able in this issue to give the first portion of a complete description of this plant, the article being especially prepared to show the character of the hydraulic development which is in many respects different from that of any other similar plant.

VIEW OF POWER HOUSE WITH WATER COMING DOWN SPILLWAY ON LEFT, ALSO SHOWING POSITION OF BRANCH PIPES COMING FROM FORCE TUNNEL AND GATES

Water is diverted from the Kern River about one-half mile below Democrat Springs, in Kern County. From the diversion dam, the water is conveyed in a conduit, which consists principally of tunnels through the mountains in a southerly direction to a point nearly 1,000 feet above the river on the mountain side opposite the intake of the Bakersfield Power, Transit and Light Company. At this point has been constructed a forebay from which the force main incline

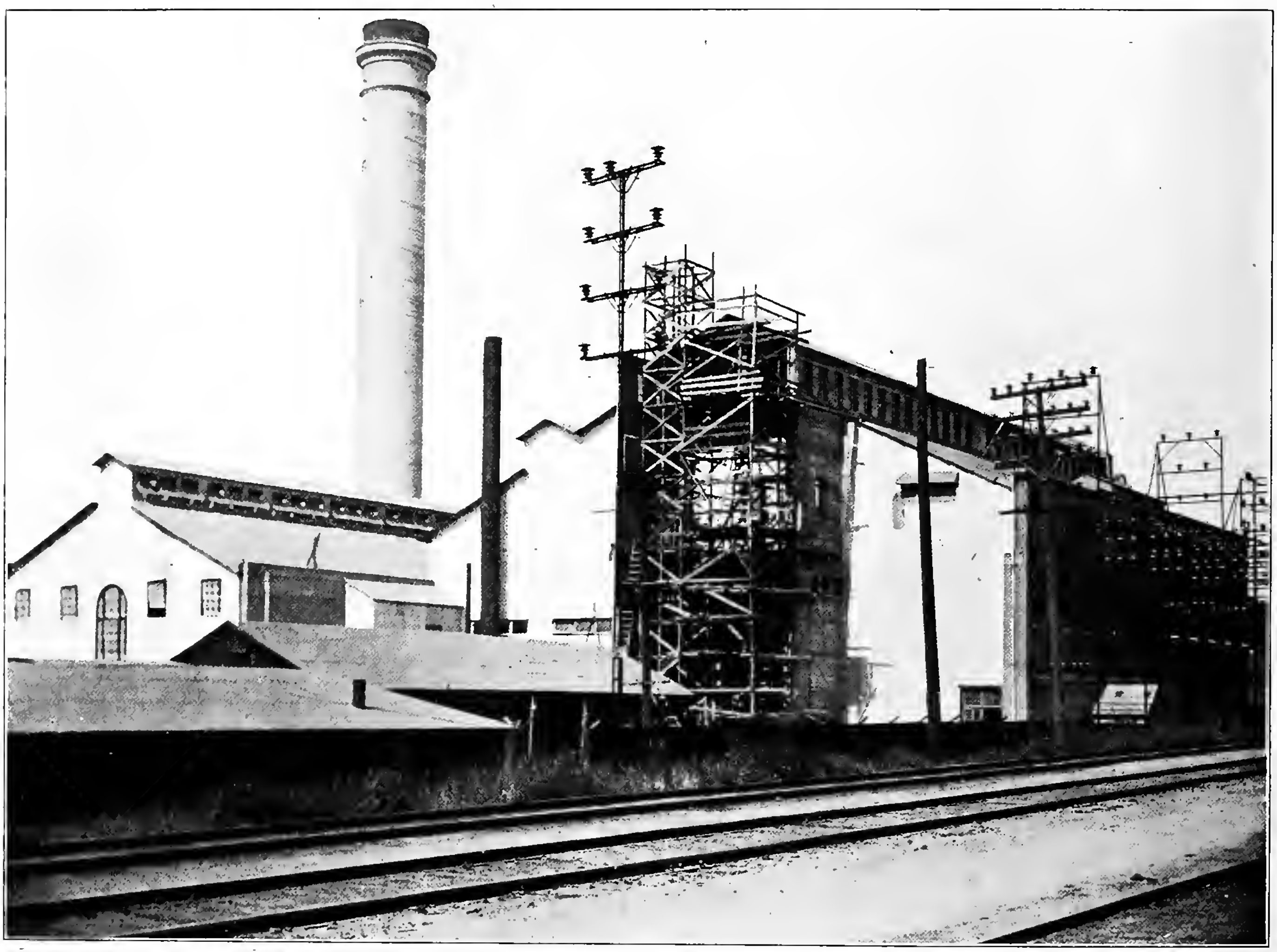
tunnel has been installed to the power house, which latter has been built on the bank of the river directly opposite the intake of the above-named company. Therefore, immediately after being used in The Edison Electric Company Station No. 1, the water is again taken from the river and utilized by the Bakersfield Power, Transit and Light Co.

The diversion dam in connection with The Edison Company's Kern River Station No. 1, consists entirely of cyclopean concrete. The dam is constructed directly on bed rock, and the crest of the dam is 1.25 feet above the flow line in the diversion conduit tunnel. The length of the dam along the crest is 203 feet. The height of the dam varies, due to the varying depth of bed rock in the river channel. The lowest point, however, of the bed rock is 35 feet below the bed of the stream.

In constructing the diversion dam, a coffer dam was built which diverted the river, while the excavations were being made in the river bed. Trenchs were then cut in the bed rock, and holes were bored into which steel bars were driven in two rows completely across the bed of the river canyon. After this preparation, the concrete was placed on bed rock and tied in by the trenches and steel bars. The diversion dam is of the overflow type, the crest being about 20 feet above the ordinary water level.

The head works of the diversion tunnel consist of enlarged and widened sections of the intake. The flow of water at the intake is controlled by gates all constructed of concrete and iron, and operated by hydraulic cylinders. Screens made of slanting iron bars extending both in front and on the side of the controlling gates, the bars being spaced about 3 inches apart, are solidly built in the tunnel, which at the location of the screens is enlarged to 6 feet, so that there will be sufficient area for the water to enter the tunnel without any contraction. The arrangement of screens is very complete, and includes a platform placed behind the screens for the purpose of raking and removing leaves and other material which might clog the screens if left where caught. The grade of the tunnel at the entrance is increased considerably in order to accelerate the water from its state of comparatively small velocity of flow in the forebay.

During construction a tunnel was built to divert the water above the diversion dam. This tunnel is now used permanently as a drainage or sluicing tunnel, and fulfills this purpose most admirably. It was driven through the bed rock below the intake, and penetrates to the bottom of the pool above the diversion dam. The entrance to this tunnel is protected by grizzlies made of 70-lb. T rails, and has two gates which are controlled by hydraulic cylinders which are operated by oil pressure, the oil being pumped by means of a triplex pump electrically driven. The oil pressure varies from 35 to 40 feet, and is increased or diminished as the amount of water flowing over the dam varies. The hydraulic cylinders are designed to move the gates under the head of water which would result if 20 feet of water flows over the dam, should such a flood ever occur.



LOS ANGELES NO. 3, SHOWING HIGH TENSION LINES ENTERING AND LEAVING

One extremely interesting feature of the hydraulic development of this plant consists of the tunnels. The character of construction of these tunnels, coupled with their permanency and size, makes the hydraulic development of the Kern River Station No. 1 of The Edison Electric Company one of the best ever built. The following table shows the number as well as the length of each of these tunnels, which aggregate approximately 8 miles between the intake and the head of the force main incline tunnel which leads the water

from the water conduit to the power house:

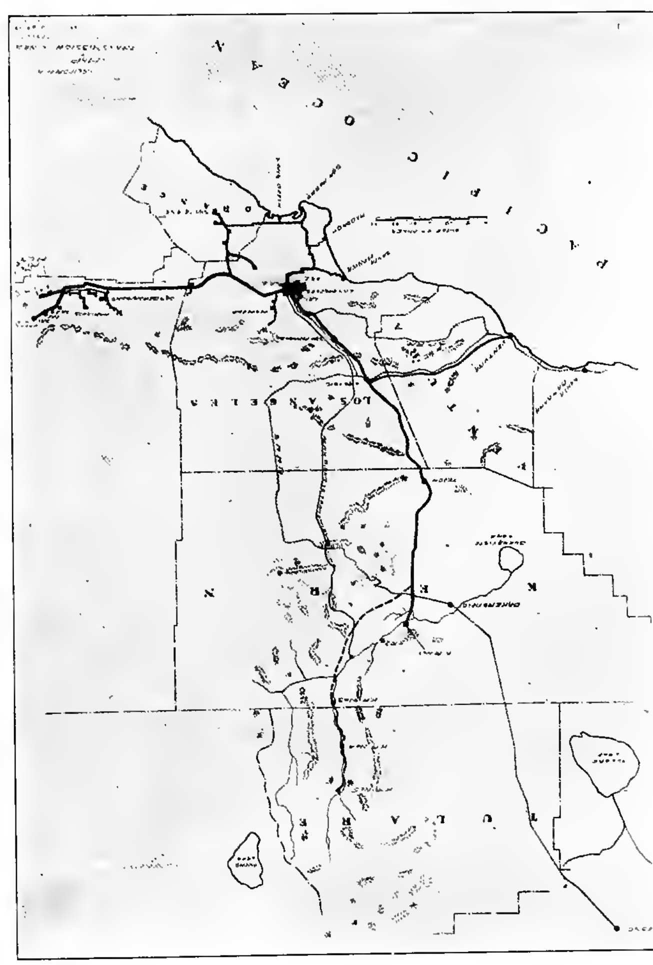
No. of Tunnel.	Length in feet.
No. 1	595
No. 2	237
No. 3	4,049
No. 4	496
No. 5	1,522
No. 6	1,805
No. 7	874
No. 8	3,816
No. 9	2,050
No. 10	3,011
No. 11	2,587
No. 12	2,170
No. 13	2,335
No. 14	4,374
No. 15	3,768
No. 16	1,498
No. 17	1,898
No. 18	2,131
No. 19	794
Total	42,910

advantageous for the purpose owing to the loose and shattered formation of the rock and other material through which the tunnels are constructed. The grade of the tunnel is 7.92 feet per mile, and it is assumed that the depth of the water will never exceed 6½ feet as a maximum. With this depth the area of the cross section of the stream will be 52 feet. The wetted perimeter is 21 feet, and the mean hydraulic radius 2.5 feet. With the grade of the tunnel as given above and assuming the co-efficient of roughness or n to be .012, the approximate capacity of the tunnels by Kutter's formula is 470 cubic feet per second.

All of the tunnels as has been set forth above are arched where they pass through seamy or shattered rock or other material. These arches were made by using a templet with lagging over head. After the lagging was put solidly in place, concrete was thrown back and on top of the lagging and thoroughly tamped in place. With this construction, therefore, the possibility of the tunnels caving in from above is practically eliminated. On the sides of the tunnels all cavities between bed rock and the concrete wall, caused by blasting in the construction of the tunnel, have been filled with riprap, the interstices of which were filled with sand and gravel.

Practically all of the excavation for the tunnels was being

WATER COMING FROM END OF TUNNEL INTO FOREBAY



MAP OF TRANSMISSION LINES, THE EDISON ELECTRIC CO.

These tunnels, as excavated in the rock, are 9 feet wide, 7½ feet high from the bottom to the spring line of the arch, and 9 feet high from the bottom to the center of the arch. All of the tunnels are lined with concrete 6 inches thick on the sides and 4 inches thick on the bottom. The entire surface of the sides and floor is plastered with cement mortar, leaving the net section of the tunnel 8 feet in width and 7 feet in height. This section of tunnel was adopted as the most

done with 3¼-inch cylinder air drills. In addition to these, some hand drilling was done, especially in opening up the approaches and in places where loose formation was encountered. The air drills were all used in the face of the rock, and the rate at which material was removed averaged approximately 5 feet for each shift of ten hours. The number of holes required for breaking the rock varied from 10 to 24 in the tunnel face, and the depth of the holes driven ran about

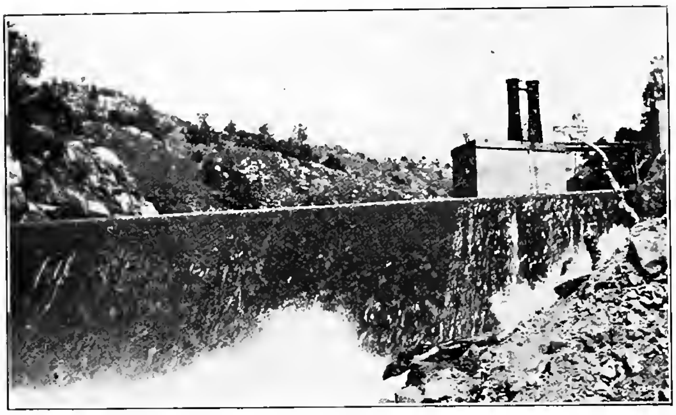
as follows:

Cut-ins—8 to 9 feet.
Lifters—6 to 7 feet.
Breast holes—6 to 7 feet.
Back holes—5 to 6 feet.

In as much as the construction of the water conduits in the tunnels was made thoroughly permanent, the timber flumes required for spanning the ravines were shortened as much as possible. In some cases timber flumes were, of course, necessary in order to preserve the general alignment and make the water conduit system as short as possible. In all cases the flumes were located so that there is little danger of rock or other heavy material falling into the flume from the mountain side above. The amount of flume construction in the entire water conduit system is given in the following table:

No. of Flume	Length in Feet.
No. 1	1,030
No. 2	130
No. 3 (Steel Flume)	50
No. 4	73
No. 5	168
No. 6	70
	1,521

All of the above flumes are wood, with the exception of



OVERFLOW DAM

flume No. 3, which has a steel frame, and is in reality a reinforced concrete flume. Foundations of concrete have been built for the entire length of the flumes, and it is believed by the engineers of the company that the construction of the frame as well as the sub-structures and flumes proper is such that their life will be between 30 and 40 years with practically no repairs. The frame work for supporting the flume boxes is made entirely of Oregon pine, in as much as there is no part of this timber which comes in contact with the earth or is exposed to water. The flume box proper is made entirely of 3-inch redwood planks sawed from the butt ends of Sequoia redwood trees. The edges of all planks are beveled and caulked with ship chandlers' oakum, the sides and seams being covered with an especially designed batten so placed that asphaltum can be poured between the batten and the side of the flume.

On the bottom of the flume hot asphaltum was poured along the seams, and before cooling 1x6 battens were nailed down, thereby entirely filling all cracks.

At all points where the flume connects with the portals of the tunnels two points of contact are offered between the wood and concrete. The construction is such that should a leak occur at the junction, the water can be pumped out of the cavity left and the leak repaired. The reinforced concrete tunnel No. 3 rests on steel frames, and the whole structure is carried on steel I beams resting on concrete piers. A frame work of structural steel for the flume is erected on these I beams, in connection with which are two layers of expanded metal, which hold the plates together, including the flume. The expanded metal is filled with concrete, which is reinforced with steel rods.

This construction is plastered inside and outside, making the entire thickness of the flume proper about 4 inches.

(To be continued.)

THE TELEPHONE ENGINEER'S PROBLEM.*

By Mr. C. E. Fleager.

I have taken this subject tonight in order to point out to you a few of the problems necessary to be considered by the telephone engineer in determining the size and layout of the complete telephone plant in any city.

The first thing to be considered is how large the telephone plant is to be and to what limits it will grow in a given time. If the field is already covered by a telephone company in operation and one wishes to come in competition with them, the study will be more complex as it will mean taking into account the existing company's plant, service, rates, etc. Assume for simplicity that we are to be the only one in the field and that we may expect to reach at least the development to be found at present in other cities.

The first step in determining the present size then would only be to ascertain the exact population of the city and multiply it by the percentage of development. This development varies in different cities and is higher on the Pacific Coast than in the eastern part of the United States. One telephone per ten inhabitants may be taken as a fair average for the Pacific Coast.

The ascertaining of the population will often be a simple proposition but can readily assume a harder aspect. Take Seattle, for example. This city had a government census population in 1900 of slightly over 80,000. Applying the average growth percentage of the whole United States will give Seattle at the present time a few less than 100,000 population. This we, of course, readily know will be too small, as the growth of this portion of the country is seen to have been much more rapid than the longer settled eastern portion of the United States. The question then is how much too small? This can be more or less accurately found out by consulting the business directories and school census of 1900 and of today, and such other public statistics as may be at hand. It will also be well to interview as many as possible of well-informed public citizens, getting their estimates and reasons for same. After the present population of the city has been decided on one can approximate the number of telephones to be connected.

Figuring from the past record of the city it will be easy to establish what growth is to be reasonably expected for coming years. Considering the possibilities of change in the method of operating, depreciation of apparatus, improvements in the system, etc., balance the construction, maintenance and operating costs to determine the number of years for which the original construction shall be planned.

Next determine the distribution of probable subscribers and figure how many exchange districts will be necessary to produce the most economical plant. To do this it will be necessary to assign to each block in the city the probable number of exchange lines and then determine by a "cut-and-try" method roughly what the construction, maintenance and operating costs will be for several different numbers of exchanges. With one exchange the average wire length of subscribers' lines will be greater than with two or more exchanges, and, therefore, construction cost of outside plant will be larger. However, the office plant will be cheaper with one exchange, as it is easily evident there will be less cost in erecting one plant to do all the work than two plants, each doing a portion and requiring intercommunication.

With one exchange the operation is much reduced, as all answering operators having the multiple jacks in front of them can complete their calls to these numbers direct, whereas if two exchanges were in use a large percentage of the calls would necessarily be trunked. That is, the percentage of trunked calls with a one-exchange plan will be much less than with two exchanges. As the percentage of trunked calls increases, the operating costs increase, as on a trunked call it is necessary for two operators to complete the connection,

*Lecture delivered to the students in Electrical Engineering at the University of Washington, Seattle.

while on a call to the multiple in front of her the "A" operator completes the connection without assistance.

In determining the proper number of exchanges it is necessary to study the geography of the city with a view of obtaining information as to possible streets on which underground and aerial systems may be constructed. Often natural divisions, such as lakes, rivers, ravines, etc., greatly increase the wire distance from any proposed exchange center to a particular section. These natural boundaries taken in account with the number of probable subscribers in that district may give a division so that the city may be studied as two separate parts. For example, the government canal, Lake Union and Union Bay divides the northern portion of Seattle from the southern.

Taking this portion of the city and taking the chart with the probable subscribers per block, obtain the wire center, figuring that there is to be but one exchange. This wire center is usually found by the graphic method as follows:

Consider that the city has only streets at right angles to each other and determining the total number of stations, draw a line parallel to one set of streets so that you have an equal number of stations on each side. This can be done by drawing a ruler down the map, counting the stations as they are passed until the half is on one side. Similarly determine the line at right angles which bisects the number of stations, and the intersection of the two lines should be the wire center, provided there are no obstacles or diagonal streets.

Where obstacles occur it will be correct to find the wire center as if there were no obstacles and to determine the number of stations which can not be brought to this center by following the shortest rectangular path. These are considered as being bunched along the nearest axis and a recount will move the wire center along that axis towards the point where the stations affected by the obstacle have been considered bunched. This new wire center will be the correct one.

Diagonal streets will tend to reduce the mileage in their district. They will not materially affect the wire center where they are found in only one quadrant of the district. Where such streets are found in two quadrants it may affect the wire center, though it is not probable. If found in three quadrants, they will probably change the location, but no method of easily determining this is known. It is necessary to figure the mileage for such stations as are affected, balancing the three quadrants against each other.

When the wire center is obtained the number of wire miles and, hence, the outside construction cost can be computed. At this time one can also determine the central office cost, probable operating cost, etc.

Then try this district with other number of exchange centers, finding the wire center for each and computing the different costs and charges. It is possible to have a separate exchange for each block or even for each subscribers' station, but of course it will not be necessary to proceed with figuring to such an extreme.

When the cost for each number of exchanges has been obtained, it will be in order to balance the fixed charges (such as interest on investment, cost of operating, etc.) one set against another and decide on the number of exchanges that gives the lowest fixed charge. It may be that there will be two different plans, giving practically the same fixed charge. In such a case decide on the one requiring the lower original investment.

In general, the correct number of exchanges will be governed mostly by the cost of the outside plant and this will be found to be a minimum when the sum of the exchange wire mileages plus the trunk mileage is a minimum. Trunk mileage will depend upon what is called specific trunk capacity; that is, the number of messages one trunk can carry in unit time.

The number of exchanges and wire centers for each being found, the next step would be to obtain information as to the purchase of real estate located at the wire centers. This would probably be referred to the business management for action, and when deeds of the property are on file the engineer may proceed with the actual planning of the construction of the exchange.

This may be divided into two parts, the inside and outside plants. In taking up the study of the inside or central office plant, will assume that the engineer has decided upon some manufacturer whose equipment is superior and with which he is supplied with full details and drawings by the manufacturer. His problem is to plan an office that will meet with requirements for a comparatively short period of time, called the "initial period," and that can be increased until the ultimate development is reached. If the number of subscribers that shall be expected is known and this has been decided in the original study of the conditions of the city, the total amount of multiple jacks can be determined, and if the ctiy is divided into two or more exchanges the number in each will have been determined.

Given, then, the size of the exchange in terms of the number of subscribers to be connected, what will be the traffic or number of daily connections to handle? To answer this question the engineer must have complete knowledge as to the policy to be pursued by the business management in the matter of rates, etc. If a flat rate charge is to be made for rental, the amount of traffic will naturally be higher than if a message or nickel rate is to be adopted. If the company has a traffic department that department should make a study of the traffic expected at each exchange, determining the number of operators necessary to handle each class of business. If no such traffic department exists it will be necessary for the engineer to make the study. It will be necessary to classify the expected stations in each exchange into such classes as hotel systems, wholesale, retail and office telephones in order to obtain a good line on the traffic.

It will also be necessary to study the direction of the traffic; that is, what traffic may be expected to occur between different exchanges. This will be necessary as it will be plainly obvious that should the "A" operators in any exchange be compelled to make all their connections to another exchange they will be unable to make as many connections as were they to complete all connections in the multiple in front of them in their own exchange.

After the probable traffic has been obtained a knowledge of the amount each operator should properly handle will decide the number of operating positions necessary. The amount of originating traffic in each exchange determines the number of "A" positions and the amount of traffic between exchanges determines the number of "B" positions. This should be determined both for the present requirements and for the requirements of the period decided on as the ultimate.

After the amount of ultimate equipment has been decided on the engineer should prepare a front equipment drawing showing all equipment and how it is to be arranged in the face of the board, also showing what is to be the initial equipment and where it is to be located. It will also be necessary to prepare plans showing the size and location of switchboards, power plant, distributing frames, desks, etc. In preparing these he will have the exact size of the lot on which he proposes to erect a building, the size of all apparatus, and will have taken into consideration the best arrangement of the various parts of the plant.

He should then prepare a specification covering in detail each part of the plant, giving the ultimate equipment desired and what shall be installed at once. This specification may, for convenience, be divided into divisions, such as subscribers' board, trunk board, power plant, etc. It should give as references, drawings showing all circuit arrangement of terminals on the distributing frames, arrangement of cables in runways, arrangement of fuses on fuse panel and all other information so that each and every part may be installed in accordance with proper plans.

If a contract is to be let for the erection of this plant, it will also be necessary to prepare additional specifications covering in detail what grade of material, methods of manu-

facture, and what inspection tests are to be made in manufacturing and accepting the plant. Specifications should also be prepared to give all information necessary for the mechanical and electrical operation of the plant.

After all the plans for the central office plant are prepared rough outlines of the building will have necessarily been prepared. These, together with information as to weight, light, heat, etc., should be handed to the architect for getting up building plans. Specifications covering the quality of material, etc., should be included in this information, as should also information about size and exact location of all special ducts, ventilators, for battery room, cable holes, and such miscellaneous items as are a portion of the telephone apparatus rather than a portion of the building proper.

The study of the outside plant requires more detailed study than the arranging of the inside plant. To reach any one particular subscriber at a distance from the exchange there are often several possible routes of nearly equal length, but which may vary greatly in actual cost of construction and in cost of maintenance. There are also several kinds of construction which give equally good service, but which vary in cost.

Outside construction may be divided into three general classes: underground cable, aerial cable, and aerial wire. The construction study consists of taking the number of stations to be connected in each block and determining from the class of business represented how many lines are necessary, and then planning the proper routes for the wires to take in going to the central office. As one gets closer to the office the number of lines along any one street becomes greater and it is therefore necessary to lay out certain streets for the grouping of the wires together, as it would be impractical to have a lead of wires down every street to the office.

These leads where the wires are grouped are called backbone or trunk leads and in modern construction are of cable, open wire being used only for distribution in the sparsely settled districts. The leads leaving the central office are underground, it being the engineers' work to determine how far this shall be carried before it is placed on poles as aerial cable. This is simply a problem of comparing the cost of construction of the underground system against a similar cost for the aerial system, keeping in mind of course the expected ultimate number of wires.

After it has been decided how much underground is necessary and on what streets it is to be located, a count of the number of wires probable will determine the size of the underground conduit system. When it is decided, plans and estimates should be drawn up to cover this work. Specifications covering quality of material and method of constructing desired should be prepared for use of contractors desiring to make bids on the work or for use of the constructing department if the company desires to do the work itself. These specifications should cover in detail all points in connection with the work in order that a definite understanding may be had.

In addition to the conduit the underground system includes manholes, handholes, and laterals. The engineer should prepare plans and specifications for these and a record to show what style and size of manholes, etc., are to be employed at the various intersections of streets, alleys, etc.

The cables to be pulled in these conduits are made by manufacturers in standard sizes and the engineer should prepare plans and orders showing size and distribution of the cables to be installed. It is customary to install a cable of capacity large enough to last for a comparatively short interval into the future.

The aerial cable backbones are handled similarly to the underground cable; that is, only enough capacity is originally installed to care for the initial period. When the number of wires to be handled ultimately are less than from 300 to 400 pairs, it is found more economical to install them aerially than in underground conduit; that is, the cost per wire mile is less. The engineer should prepare plans showing the initial distribution, giving the wire numbers that are to be dropped out at all distributing points.

He should prepare specifications, giving in detail all information regarding material and methods to be employed in setting poles, hanging cable, and taking out distributing terminals.

In the distributing from the backbone leads two general classes are to be observed. Those in which the distribution can be made underground and those in which it is made aerially. The underground distribution is usually made to business blocks, a terminal being placed in some convenient location (usually the basement) and distribution made from this terminal with the building wiring. A good method of building wiring is to run cable from the terminal in the basement to each floor (allowing sufficient pairs for each room), locating a terminal box in the hallways in which branch cables are terminated. Moulding can then be placed in the hallway connecting these terminal boxes with the different rooms. Wire can be placed in the moulding as the service is demanded, but the cable should be placed when the building is constructed.

In the aerial distribution which is usually in residence districts, pole lines are run down each street or alley carrying a cable large enough to handle the street for the ultimate. Multiple terminals are taken off at frequent enough intervals so that service or drop wires can be run direct from the terminal pole to the subscriber's premises. These terminals are usually of smaller size than the cable and are arranged in some systematic order to allow of all pairs having the same number of multiples. This should be covered by specifications by the engineer so that a standard may be adopted and followed. It should be the aim of the engineer in all his specifications to adopt some standard and follow it.

For the wiring of houses for telephones some specification should be prepared to cover all points liable to arise, keeping in mind the best construction at a minimum cost. Insurance regulations and concealment and neatness should be carefully considered in preparing this specification.

UNIVERSITY EMPLOYMENT AGENCY.

In order to serve employers more promptly and effectively during the summer, as well as throughout the academic year, the University of California has established a special registry for its graduates who are seeking positions. Chemists, engineers, architects, draughtsmen, surveyors, bookkeepers, bank clerks, stenographers, etc., are now registered by the appointment secretary, who secures evidence in regard to each man's qualifications and who is prepared to furnish this information to employers at any time. Business houses may be supplied with men for almost any line of work, the College of Commerce furnishing men especially fitted for taking up mercantile work. The College of Mining sends out men trained for work as mining engineers, assayers and prospectors.

Many undergraduates are registering for work during the summer vacation, which runs from May 15 to August 15. Summer hotels may obtain extra clerks, and railroad surveying parties men for work with the chain and rod. Men may be found for fruit picking and packing, for work with express companies and in stores. In making application for men, employers are asked to state clearly the work to be done, when it must begin and the pay offered. Also please state whether the work will be temporary or permanent, and the cost of living, if possible. Address Gurden Edwards, alumni secretary, 203 California Hall, Berkeley, California

RULE OF THUMB VS. ENGINEERING.

In a recent issue of the Electrochemical & Metallurgical Industry, there appears an interesting essay by Mr. Joseph W. Richards, professor of metallurgy in Lehigh University, in which he says that the "engineer" is one who strives to perfect his work, the "artisan" works to get through with it; the first labors for intelligent love of his work, the latter "quits when the whistle blows"; the first puts "gray matter" into his labor, the latter only muscle and experience.

Ever since man emerged from prehistoric savagery, the one who weighed chances, measured his resources, and ordered his actions by intelligent foresight, has earned the place and deserved the title of "the fittest." Engaged as we all are in receiving impressions, recording observations, gaining experience, that man alone is wise who profits by this information to lay down rules for the guidance of his future conduct, for the ordering of his future actions.

The English definition of an inch is that it is "the twelfth part of a foot and equal to three barleycorns." The foot was, of course, originally the average length of the pedal extremities of a race of people, and it was not only natural but inevitable that, for example, the French foot should differ in length from the German foot, etc. Not wishing to pursue this branch of our inquiry to too great and perhaps tiresome lengths, we may as well recite at once a striking and suggestive fact, whose connection with our argument may not be at once apparent, namely, the French word for an inch is pouce, which is also French for the thumb. The connection implied, is, of course, that an inch, in France at least, and probably in England also, was originally the length of the second joint of the thumb, which varies less in different people than would at first thought be imagined.

In the absence, therefore, of a proper foot rule marked into inches and fractions, it was customary at one time to measure lengths of small dimensions with the thumb joint, and so get an approximation of the number of "thumbs" in a given length. It would be ill-adviseu, if not conceited, for us to poke fun at or wax sarcastic about the absurdity of such practice, for the "rule of thumb" was a valuable practice when compared with what it displaced—no rule at all; and just as imperfect laws are better than total lawlessness, so the "thumb rule" marked a decided advance toward the arts and sciences.

Somewhere later in time than the period we have been considering, measures of length accurately compared with an arbitrary standard began to multiply and to displace the "rule of thumb." Artisans could then begin to work with exactness, the carpenter could plan and scheme ahead accurately by measure, the smith could forge articles to any required stated size, the gentleman could order from his tailor trousers so many inches long, without allowing for the different lengths of thumb of his sartorial "churls." This period having arrived, and this stage of advancement in the arts and sciences having been reached, we are now prepared to let loose the vials of our criticism, or, perhaps, indignation, and with perfect justification, upon the unlucky wight, who, either from inborn "cussedness" or acquired laziness, continues to afflict humanity with "the rule of thumb." Here is the unpardonable sin: the accurately divided rule has come and the confirmed sinner sticks to his "thumbs" and "barleycorns."

Having dragged the reader through this somewhat misty prologue, it is becoming that we state exactly what we mean to preach further about. It is just this: The difference between "rule of thumb" and accurate calculation, the wide gulf separating the hit-or-miss, cut-and-try methods of the ancients and the scientifically informed practice of the modern technologist. Not that we are going to hold up the former to ridicule or the latter to extravagant adulation, but we wish to discuss some of the features of modern technology which illustrate the great change which has taken place and the still greater changes which are possible.

To take an illustration from civil engineering: Spanning the Firth of Forth, a few miles above Edinburgh, stands the greatest structure of th epresent time. With clear spans of 1700 feet, capable of carrying the heaviest trains, the strains and stresses in each of its thousands of members all accurately calculated beforehand, here is a monument to engineering skill absolutely unthinkable as a product of "rule of thumb."

Look once more at the electrical engineer and his achievements. A huge dynamo spins like a top on a shaft 160 feet deep and develops in the smallest compass imaginable 10,000 horse power. The diameters of the armature wires are accurate to the thousandth of an inch, the hundreds of turns of wire are neither one too few nor one too many, the very phases of the pulsations of the electric waves are mapped and studied out so as to bring out the maximum efficiency. Soft iron from Norway, mica from Canada, rubber from Paraguay, copper from Arizona, shellac from China, steel from Pennsylvania are combined with the most consummate skill and accurate calculation into a huge giant, which works day and night with almost the regularity of a planet. "Rule of thumb" could never have conceived of such a product; only "engineering skill" has made it possible.

One art and one science still bear much of the stigma of "rule of thumb"—the science of chemistry and the art of metallurgy. Chemistry remained alchemy until the invigorating breath of modern methods commenced to blow away the mists of mystery which enveloped it. The evolution has been long and laborious. Conservatism in the manager combined with stubborn old-fogyism in the workman, have conspired against enlightening methods to keep the industry in the rule-of-thumb rut. Germany was the first country to break away into scientific and engineering chemistry, and the lead thus gained has been maintained to this day. The Britisher, workman or manager, is the most conservative of human beings, and his backwardness in following Germany's methods is the chief cause of the industrial difficulties under which the British chemical industry now labors. Metallurgy is still rule-of-thumb in many countries, such as Central Africa (production of iron), China (production of lead and mercury), Straits Settlements (reduction of tin), where aboriginal methods still largely survive. But the aboriginal spirit is preserved in many other so-called civilized countries. It persists among the Cornish and Saxon tin workmen, the Derbyshire and Corinthian lead smelters, the Welsh and Mansfield copper refiners, the Alaskan and Siberian gold winners, the Missouri and the Silesian zinc distillers, the Almaden and Idrian mercury mines, the Eastern Pennsylvania as well as the Lithuanian blast furnaces.

Among all of these, and others too numerous to mention, are to be found that reverence of tradition, that willingness to keep plodding in the rut, that indisposition to apply the discoveries of modern science, that ignorance of what modern science has disclosed, which keep them groping in the semi-darkness of medievalism, while their more intelligent neighbors are running away from them like an express train distancing a stage-coach.

The Electric Storage Battery Company of Philadelphia have just issued the tenth edition of their Price List "X," which describes their Exide type of battery in electric vehicles and sparking service. Copy of this price list will be forwarded upon application to any of the company's sales offices or Exide depots.

The JOURNAL OF ELECTRICITY
POWER AND GAS
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The Engineers', Architects' and Builders' News

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EASTERN AGENCIES
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CHICAGO ....
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LOS ANGELES ....
PORTLAND ....
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Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," with which is incorporated "The Engineers', Architects' and Builders' News."
Entered as second-class matter at the San Francisco Post Office, August 15, 1899.
Entered as "The Electrical Journal," July, 1895.
Entry changed to "The Journal of Electricity," September, 1895.

VOL. XVIII JUNE 1, 1907 No. 22

EDITORIAL.

The Real Situation in San Francisco—What is It?

It is impossible for any citizen with eyes to see, if he be not blinded by ulterior motives, immediate profit or reckless partisanship, to ignore the conditions in San Francisco today. As a part of the nation and the State, the people of San Francisco are sailing through a Scylla of Labor and a Charybdis of Capital. The problems of industrial economy, involving the co-operative and equitable division of both profit and loss, have been thrust upon us with precipitate suddenness. Some of us who have seen a little distance in the future have hoped that such problems would not need to be solved in our day, but might be left to be worked out by the next generation. We, who have seen San Francisco built up and then torn down by ruthless elements in the space of only three days, have imagined that there was enough for us to do without attempting to solve the severest, though inevitable questions, which have made capital and labor antagonistic instead of, as the natural laws of economy direct, thoroughly co-operative and sympathetic.

But the situation is upon us, and with that dauntless spirit, which each fateful dawn gave fresh heart to the pioneers, we must not flinch and fail to do the duty of our day. There is no occasion to indulge in gloom or supplication over the grievous quarrels that now overwhelm San Francisco. Rather must we strive to face the difficulty fairly, squarely and honestly with no ulterior motives, in the hope of finding a way over them.

"Quit ye like men" should be the watchword of the hour; like fair and honest men of intelligence and strength. If we ignore the complaints of the downtrodden—even though their grievances may seem trivial or imaginary—we are not just, and indeed, the same fairness is needed toward those of high estate whose names to-day are the by-word of the newspapers and the targets of prosecution. Toward what end are we expending our energies, our complaints and our disorders? Is our goal peace and prosperity, or will the result be riot and revolution?

Even the argument of the Socialist is not to be carelessly cast aside. It must be considered with patience. Only this week a London correspondent of the "Journal" writes:

"Socialism as exemplified in England is a system of degeneration; a palsied thing. The conversion of Great Britain to Socialism would have meant its perversion into a gigantic workhouse."

The "workhouse" in England is the last resort of the improvident and the vicious. The wise men of England, among whom we may safely include our correspondent, thank heaven, and their sturdy ancestors too, that "the thing" got a "thorough knock-out" at the last municipal election.

Sometimes it is well—yes, even necessary—to get away from our immediate environment in order to get a true perspective of ourselves. In an interview this week Lord Rothschild, the head of the greatest financial power in the world, said:

"The best that can be said is that the markets are no worse to-day. Perhaps they are slightly better, but with President Roosevelt attacking the railroads in one part of the world, the income tax question and other problems in France, and the Socialist movement in England, the people are killing the goose that laid the golden eggs, and we can expect nothing more than what the market position reveals."

Suppose Capital should choose to grow weary of the strife with Labor and shut up shop, realizing upon its securities in this country as best it could and retire abroad in Astorian or Carnegian vein: What, then, would happen to Organized Labor? Even we, the consumers and the passengers, the third party to the strife, would inevitably suffer.

Labor may strike at Capital, but in the meantime, also, in our time, at least, it is obviously possible for Capital to as effectively lock up Labor. The "Journal" holds no brief for either the special privileges of the few—whose rule in politics has been predominant—or for the exorbitant demands of the Labor Trust. We deplore the extravagances of both classes, and as well the fact that, instead of marching side by side to the goal of industrial peace and prosperity,

they should be so perpetually and so fatally aligned against each other.

In our own case—the troubles and disorders, industrial, political and social, which now vex San Francisco—we must keep cool heads and strong hearts. We must fight valiantly for industrial freedom—for the lawful rights of the individual—or inevitably succumb to the thraldom of Labor Union dictation and tyranny.

Nor is it possible to ignore the fact that the situation indicates that some private conspiracies may beset us. Mr. Rudolph Spreckels and his associates have undoubtedly done much good in uncovering graft and corruption in San Francisco, but it is well to ask ourselves if there is even a remote possibility of there being wolves in sheep's clothing among us. No possible autocracy—concentration of political and industrial power in a single individual, or, indeed distributed among a single class—is possible if we would maintain our heritage of Republican institutions and the faith of our fathers. It must be admitted that there are keen and far-seeing observers who fear that the graft prosecutors in San Francisco are being used —beyond their kin—in a gigantic conspiracy to concentrate the control of public utilities and political power within far narrower and more dangerous limits than those which have existed in the immediate past.

Suppose for a moment that the seeming ambitions of the graft prosecutors were completely gratified; that the men in charge of the management of the United Railroads, the Telephone Company, and the Gas and Electric Company, were all sent to the penitentiary. Also that the franchises of the United Railroads were all cancelled and that the direction, and hence eventually the ownership, of all of the above-named public utilities were to pass into other hands.

Can it be said that those who have made possible the exposure of graft in San Francisco are infallible and omnipotent? Are they actually so superior to the rest of us that they would direct such interests, both industrial and political, against their own ambitions, working solely and wholly for the public good, inspired only by patriotic and unselfish impulses? Even were such admirable persons to be found anywhere in San Francisco, would such a condition be worthy of our American and Republican institutions, or significant of our independence and consistent with our birth right as free-born Americans? We do not wish to imply that there are those interested in the prosecution of graft in San Francisco who are in reality not what they seem, but in the interests of all, we most earnestly recommend the contemplation of these dangers to each and every one having the ultimate future greatness of San Francisco at heart.

Whatever Mr. Patrick Calhoun may have done, he, with his other associates of the Telephone and Gas and Electric companies, who are under a cloud, have done inestimable service to San Francisco and California. Mr. Calhoun, almost alone, has successfully waged a battle for industrial freedom in San Francisco, and his victory will do more for the city's future greatness than any other thing which could have been done; and if there be hidden conspirators in any disguise, it is certain that Mr. Calhoun and the United Railroads will never cease fighting back until ultimate victory is won and the people of San Francisco have revealed to them the real situation. They scorn the tyranny of such government as we have bowed to since the confession of the conscienceless Supervisors; they are alert to the dangers that menace the enterprise and honesty of individual effort. Nor are they to be terrorized by the calumnies or assaults of an unlicensed press. They declare they have nothing to be ashamed of, and are prepared to prove it.

Let us, then, exercise patience and wisdom, and if we are really seeking the truth, we undoubtedly will be rewarded; but in the meantime let us be prone to no hero worship, and let us guard with the utmost vigor our complete independence, both of action and judgment. Before we accept any one as the undisputed dictator in San Francisco, let us await with patience until without question we know surely and for all time what is the "real situation."

PERSONAL

Garnett Young, manager of the Telephone and Electric Equipment Company of San Francisco, was in Los Angeles during the past week.

George Nixon, of Nixon & Kimmel, electric engineers and contractors in Spokane, Wash., has returned home after a short business trip to San Francisco.

Otto E. Falch, Jr., has opened offices as consulting electrical and mechanical engineer at 850 Monadnock Building, San Francisco, having resigned his position as chief engineer of the Pacific Coast department of the Otis Elevator Company.

TRADE CATALOG

Allis-Chalmers Co., Milwakee, Wis., send Bulletin No. 1058, describing and illustrating the Winona Interurban Railway, between Warsaw and Goshen, Indiana. No. 4005 shows Allis-Chalmers steam turbines and generators recently put in service.

The Holtzer-Cabot Electric Co., Brookline Station, Boston, Mass., sends three interesting bulletins. No. 302A displays the uses of their dynamotors, double-wound machines, in which one armature core holds both motor and generator windings which rotate in a common field, and of their motor generators in which a motor and dynamo are mounted on a common base and connected by means of a coupling, each armature rotating in its own field. These are built in many sizes, from the smallest to the largest. Bulletin No. 303A illustrates and describes their special elevator motors. Bulletin No. 311 contains an interesting account of direct-connected electric generating sets for gas, gasoline or alcohol, sizes 3 to 60 horsepower.

LOCAL STOCKS AND BONDS

Furnished by Courtesy San Francisco Stock and Bond Exchange.

Outstanding	Interest	Miscellaneous Bonds.	May 23		May 24		May 25		May 27		May 28		May 29	
			Bid	Asked	Bid	Asked	Bid	Asked	Bid	Asked	Bid	Asked	Bid	Asked
1,532,000	F & A	Associated Oil Co. 5%						82		82		82		82
2,250,000	M & S	Bay Counties Power Co. 5%		101		101		101		101		99		99
1,000,000	F & A	Cal. Central Gas & El. 5%		104		104		104		104		104		104
9,600,000	M & S	Cal. Gas & El. Gen. M. & C. T. 5%	75	79		81		80	75		77½	80	75	80
900,000	J & J	California St. Cable Co. 5%	100		100		100		100		100		100	
2,000,000	J & J	Contra Costa Water Co. 5%		103		103		103		103		103		102½
1,000,000	J & J	do do Gen. Mtg. 5%		97		97½		97½		97½		97½		97
623,000	F M A N	Edison Light & Power 6%	111	119	111	119	111	119	111	119	111	119	111	119
650,000	M & S	Ferries & Cliff Ho. Ry. 6%	104		104		104		104		104		104	
671,000	A & O	Geary St. Railway 5%	45		45		45		45		45		45	
610,000	M & N	Honolulu R. T. & L Co. 6%	104¾		104¾		104¾		104¾		104¾		104¾	
300,000	A & O	Lake Tahoe Ry. & T. Co. 5%												
500,000	J & J	Los Angeles Elec. Co. 5%	100		100		100		100		100		100	
1,300,000	J & J	Los Angeles Gas & Elec. Co. 5%		100		100		100		100		100		100
5,000,000	A & O	Los Angeles Ry. 5%	105		105		105		105	108		108	104	107
1,000,000	A & O	Los Angeles Lighting Gd. 5%		105		105		105		105		105		105
1,500,000	A & O	L. A. Pac. R. R., 1st Con. Mtg. 5%		104		104		104		104		104		104
3,030,000	M & S	L. A. Pac. R. R. of Cal. 5%		100¼		100¼		100¼	98½		98½		98½	
3,000,000	J & J	Market Street Cable 6%		110		110		110		110		110	105	
5,141,000	M & S	do Ry., 1st Cons. Mtg. 5%		105		107½		107½		107½		104½		106
100,000	A & O	Mill Valley & Mt. Tamalpais S. Ry. 5%		103	102		102		102		103		103	
4,751,000	A & O	Northern Ry. Co. of (Cal.) 5%	107½	110	108	110¼	108	110¼	109	110	109	110		110¼
1,498,000	J & J	North Pacific Coast R. R. 5%		103		102½		102½		102½		102½		102
1,074,000	J & D	Northern Cal. Railway 5%												
980,000	J & D	Northern Cal. Power Co. 5%								101		101		101
6,000,000	A & O	Northern Electric Co. 5%		97½		97½		97½		97½		97½		97½
1,000,000	M & S	Oakland Gas Light and H. 5%		107	02	106⅞	102	106⅞	102	106⅞	102	106⅞	102	106⅞
1,374,000	J & J	Oakland Transit Co. 6%		114		114		114		114		114		114
1,600,000	J & J	Oakland Transit 5%	101		101¼		101		101½		101½		101½	
1,326,000	J & J	Oakland Transit Con. 5%		101									100	101¼
7,000,000	J & J	Oakland Traction Con. 5%		100½		100½	99¼			100¼		100¼		100¼
1,500,000	J & J	Oakland Water Co. gtd. 5%		97½		99		99		99		99		99
2,000,000	A & O	Omnibus Cable Ry. 6%	112	118	112	118	112	118	112	118	112	118	112	118
1,149,000	S D M J	Pacific Gas Imp. 4%		92½		92½		92½		92½		92½		92½
8,494,000	J & J	Pacific Electric Ry. Co. 5%	100	104	02	102½	102	102½	102		102	103½	101¾	102½
4,491,000	J & J	Pacific Light & Power Co. 5%		100½		100½		100½		100½		100½		100½
3,000,000	J & J	Pacific Tel. & Tel. Co. 5%		103		103		103		103		103		103
350,000	J & J	Park & Cliff House Ry. 6%	100		00		100		100		100		100	
250,000	J & J	Park & Ocean R. R. 6%		112½		112½		112½		112½		112½		112½
700,000	M & S	Powell Street Railway 6%		107½		107½		107½		107½		107½		107½
2,500,000	M & N	Sacramento Elec. Gas & Ry. 5%		100½		100		100		100		98		100
6,000,000	A & O	S. F. & S. J. Valley Ry. 5%		111	108	110	108	110	108¼		108		108¼	
3,000,000	J & J	S. F., Oak. & San Jose Ry. 5%	102	109		105½	100			105		105	100	107
1,500,000	J & J	do do 2d Mtg. 5%		101		101		101		101		101		101
1,500,000	A & O	S. J. & S. Clara Co. R. R. 4½%		91		91		91		91		91		91
642,000	A & O	Sierra Ry. of Cal. 6%	107		107		107		107		107		107	
6,000,000	J & J	S. P. R. R. of Arizona 6% (1909)	103	103¾	103	103½	103	103½	103	103½			102⅞	103½
4,000,000	"	do do do (1910)	103¾	104¾	03⅞		103¾		103¾		103¾		103¾	
5,116,000	A & O	S. P. R. R. of Cal. 6% (1912)	105½		05½		105½		105½		105½		105½	
4,127,500	M & N	S. P. R. R. of Cal., 1st c. gtd., 5%	112½	117	14	116½	114	116½	114	116½	114	116½	114	116½
3,533,000	A & O	S. P. Branch Ry. of Cal., 6%	121¾	122½	21¾		121¾		121½	130	121½		121½	
81,178,000	J & J	S. P. R. R. Co., 1st Ref'd'g. 4%	90½	91¼	90½	91	90	91½	90	91½	90	90½	90	
17,500,000	J & D	Spring Valley Water Co. Gen. Mtg. 4%		88		88		88		88		88		88
300,000	M & S	Stockton Gas & Elec. Co. 6%	100		100		100		100		100		100	
2,000,000	J & J	United Gas & Elec. Co. 5%												
20,000,000	A & O	United R. R. of S. F. 4%	65	68½	69½		69⅞		69½	71	69½	70	69⅞	70
2,500,000	M & N	Valley Counties Power Co. 5%		102½		100¼		100¼		100¼		100¼		100¼
		Water Stocks.												
		Contra Costa	60½	62	60½	62	55	61	55	61	55	61	55	61
6,000	Quarterly	Marin County		62		62		62		62		62		62
280,000		Spring Valley Water Co.	18½	19	19	19½	19	19¼	19		19		19	
		Gas and Electric Stocks.												
37,500		Martel Power Co.												
9,340		Mutual Elec. Light Co. (Ctfs.)	4½		4½		4½		4½		4½		4½	
37,336		do (Extended Ctfs.)	12½	13¼	12½	13½	12½	13½		13¼		13¼	12½	13¼
40,000	Monthly	Pacific Lighting Co.		65		65		65		65		65	58	
12,000		Stockton Gas & Elec. Co.	52		52		52		52		52		52	
		Street Railroad Stocks.												
10,000		California		142½		142½		142½		142½		142½		142½
10,000		Geary		41		41		41		41		41		41
10,000		Presidio		25		25		25		25		25		25
	Semi-an.	Associated Oil Co.	29¾	30½	32		34¼		34¼	35	34½		34	
1,625	Quarterly	Mill Valley & Mt. Tamalpais S. Ry.		110		110		110		110		110		110
180,000	Quarterly	Pac. Tel. & Tel. (Pfd.)		100		100		100		100		100		100
180,000		do do do do (Common)	7½	15	7½	15	7½	15	7½	15	7½	15		15

Unlisted Securities

Outstanding	Interest		May 23 Bid	May 23 Asked	May 24 Bid	May 24 Asked	May 25 Bid	May 25 Asked	May 27 Bid	May 27 Asked	May 28 Bid	May 28 Asked	May 29 Bid	May 29 Asked
750,000	A & O	Bay Counties Power Co. 6%		103		103		103		103		103		103
745,000	M & S	Blue Lakes Water Co. 6%												
2,000,000	A & O	California Northwestern Ry. 5%		108		108		108		108		108		108
160,000	J A J O	Marin County Water 5%		100		100		100		100		100		100
600,000	J & J	Risdon Iron Works 5%		100		100		100		100		100		100
500,000	M & S	S. F. Dry Dock 5%		109		109		109		109		109		109
8,000,000	M & N	S. F. Gas & Electric 4½%		95		95		95		95		95		95
3,926,000	J & J	S. F. & North Pacific Ry. 5%		107½		107½		107½		107½		107½		107½
5,500,000	J & J	South Pacific Coast Ry. 4%		95		95		95		95		95		95
		Standard Electric Co. 5%		92½		92½		92½		92½		92½		92½
		do do Gtd. 5%		95		95		95		95		95		95
750,000	J & J	Sunset Tel. & Tel. Co. 6%												
2,250,000	A & O	Sunset Tel. & Tel. Co. 5%		105¼		105¼		105¼		105¼		105¼		105¼
1,000,000	M & N	Sutter Street Railway 5%		105		105		105		105		105		105
		Stocks.												
50,000	Monthly	Gas Consumers' Association												
100,000	Monthly	Northern Cal. Power Co.		23	19	22	19	22	19	25	17½	20		20
		Pac. Gas & Elec. (Pfd.)		55		49½		55		49		50		50
		Santa Cruz Port. Cement		65		62		62		62		65		62
		Standard Port. Cement (New)		60	15		15		15	17	15	17	15	17
50,000	Monthly	Truckee Electric Co.	15			60		60		60		60		65

APPROVED ELECTRICAL DEVICES.

This department from time to time will contain an illustrated description of all fittings approved by the Underwriters' National Electric Association.

CONDUIT, OUTLET BUSHING.

"Fox" terminal hood. A cast-iron plate and cover for service entrance. Approved for use at service entrance only April 9, 1907. Manufactured by

Fox Mfg. Co., Milwaukee, Wis.

FIXTURES.

O'Brien, show window and show case reflector and lamp. A tubular 16 candlepower, 110-V. lamp, mounted on special porcelain sockets, in metal frame. Approved April 26, 1907. Manufactured by

O'Brien Electric Light Company, Philadelphia, Pa.

FUSE, CARTRIDGE ENCLOSED.

"B.-P." All capacities, 250-V. Approved April 22, 1907. Manufactured by

Briner-Pogue Mfg. Co., St. Louis, Mo.

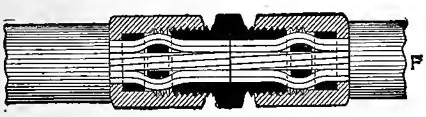
"Shawmut," standard type, all capacities, 250 and 600-V. Approved April 22, 1907. Manufactured by

Chase-Shawmut Company, Newburyport, Mass.

MISCELLANEOUS.

"Dossert" cable joints. Splicing devices for use without solder. Types A, B and C. Approved April 27, 1907. Manufactured by

2 WAY TYPE A



2 WAY TYPE B

Dossert & Co., New York, N. Y.

G. E. ground connection pipe clamps, removable lugs bolted to strip bronze clamps, all sizes. Cat. Nos. 4325, 4330, inclusive. Approved April 22, 1907. Manufactured by

General Electric Company, Schenectady, N. Y.

PANELBOARDS.

Crouse-Hinds, 125 and 250-V.; 2-wire, equipped with standard type enclosed fuse cut-out. Approved April 26, 1907. Manufactured by

Crouse-Hinds Co., Syracuse, N. Y.

SOCKETS, MINIATURE.

Hubbell, candelabra pull socket, ½-A., 125-V., and candelabra extensions ½-A., 250-V. Approved April 26, 1907. Manufactured by

Harvey Hubbell, Bridgeport, Conn.

CABINETS.

G. E. wooden, asbestos lined, except for use with metal conduit systems. Approved April 6, 1907. Manufactured by

The General Electric Co., Schenectady, New York.

FLEXIBLE CORD, PENDANT.

Tag on coil to read "Guaranteed Nat'l Elec. Code Standard."

Marking: Yellow cotton thread cabled with copper strands. Approved April 3, 1907. Manufactured by

American Electrical Works, Providence, R. I.

Marking: Soft woolen thread on rubber surface lengthwise of wire and under braid. Approved April 3, 1907. Manufactured by

American Steel & Wire Co., Worcester, Mass.

Marking: Red, white and blue thread, cabled with copper strands. Approved April 3, 1907. Manufactured by

Crescent Insulated Wire and Cable Co., Trenton, N. J., for Alfred F. Moore, Philadelphia.

Marking: Green threads in cotton wound around copper strands. Approved April 3, 1907. Manufactured by

General Electric Co., Schenectady, N. Y.

Marking: Two ridges on rubber insulation. Approved April 3, 1907. Manufactured by

Goodyear Rubber Insulating Co., New York.

Marking: Blue cotton thread, cabled with copper strands. Approved April 5, 1907. Manufactured by

National India Rubber Co., Bristol, R. I.

Marking: Ridge on rubber insulation. Approved April 3, 1907. Manufactured by

Okonite Company, Limited, New York.

Marking: One red thread cabled with copper strands. Approved April 3, 1907. Manufactured by

John A. Roebling's Sons Co., Trenton, N. J.

Marking: Yellow thread in cotton wound around copper strands. Approved April 3, 1907. Manufactured by

Safety Insulated Wire and Cable Co., New York.

FLEXIBLE CORD, PORTABLE.

Marking: Red cotton threads upon smooth rubber surface lengthwise of wire and under braid. Approved April 3, 1907. Manufactured by

Simplex Electrical Co., Boston, Mass.

Also each brand approved under flexible cord, pendant, was approved under flexible cord, portable.

ROSETTES, LINK FUSE.

"Bryant Junior" cleat, Cat. No. 1501, and concealed No. 1502, combined cleat and fusible rosette, No. 965, 2-A., 125-V. Approved April 26, 1907. Manufactured by

Bryant Electric Co., Bridgeport, Conn.

SWITCHES, AUTOMATIC.

Pettingell-Andrews for remote control, up to and including 200 A., P. C., 250 A., A. C. 440 V. One, two or three pole toggle mechanism, operating laminated copper switch blades by means of control circuits energizing magnates, with or without special iron box. Control circuit to be wired throughout as for low potential systems. Approved April 29, 1907. Manufactured by

Pettingell-Andrews Co., Boston, Mass.

INDUSTRIAL

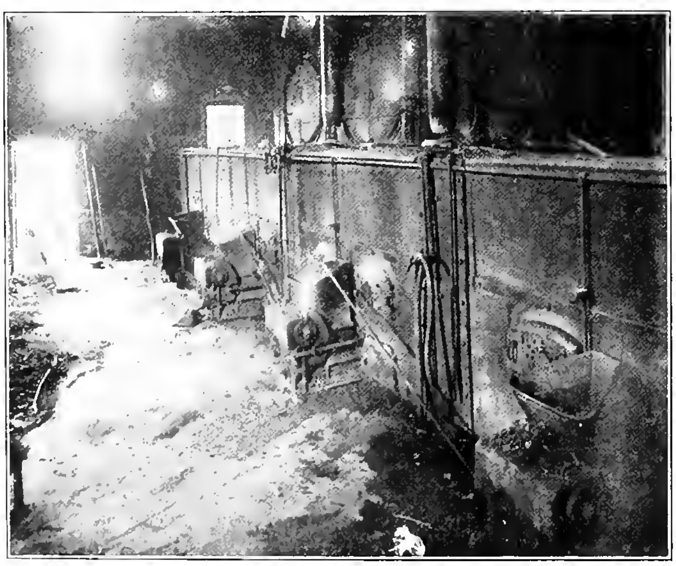
ELECTRICAL EQUIPMENT OF THE GRAND RAPIDS PULP AND PAPER COMPANY, GRAND RAPIDS, WISCONSIN.

The power requirements of pulp and paper mills present many problems arising from conditions peculiar to this class of industries. Continuity of service and uniform speed are essential to the successful manufacture of paper, as when a run is started it must be continuous and any lack of uniformity in speed seriously affects the quality of the product. The starting conditions of some of the machinery are severe and a large overload capacity in the motive power is therefore necessary.

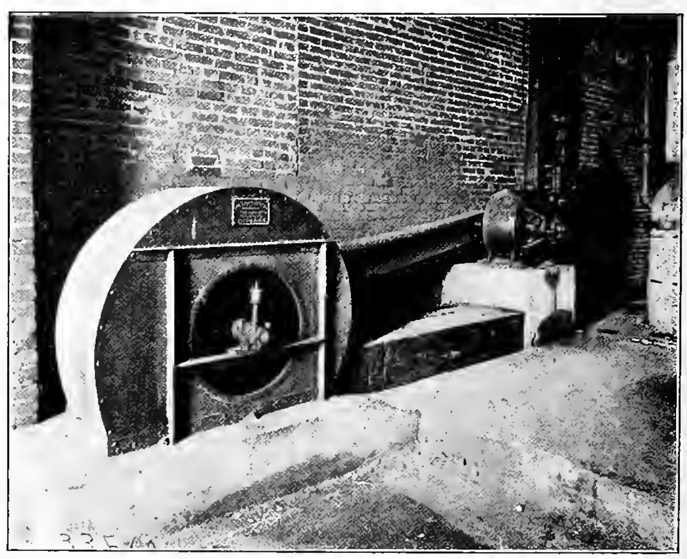
Electric motors have been found to fulfill all these requirements and have been adopted to a large extent by pulp and paper manufacturers. Many advantages are derived from their use that to a large extent eliminate the objectionable features of mechanical transmission. A flexibility is gained which permits the subdivision of units to such an extent that power may be delivered directly at the various points of application, thus eliminating the use of long lines of shafting and belting with their many attendant disadvantages, and the control of each section or individual machine is placed directly in the hands of the operative.

Another important feature is that portion of paper machines that operate at variable speeds, which includes the wire, press rolls, dryers and machine rollers. It is essential that the speed variations cover a considerable range, be easily controlled and complexity avoided as far as possible. In existing direct current plants or mills where it is deemed advisable to install direct current motors, the variable speed feature is taken care of by the use of variable speed motors, regulated by field control, which have a sufficient range to entirely eliminate the use of mechanical speed changing devices, which are necessary where mechanical transmission of power is used. This greatly simplifies the system and prevents the loss of power in overcoming the friction of belts and moving parts. The variable speed motor is easily controlled and has a definite known speed for each notch of the controller, which gives the operator an intelligent conception of the speed of his machine at all times. This is in great contrast to mechanical speed changing devices, which require

VIEW OF WISCONSIN RIVER SHOWING DAM



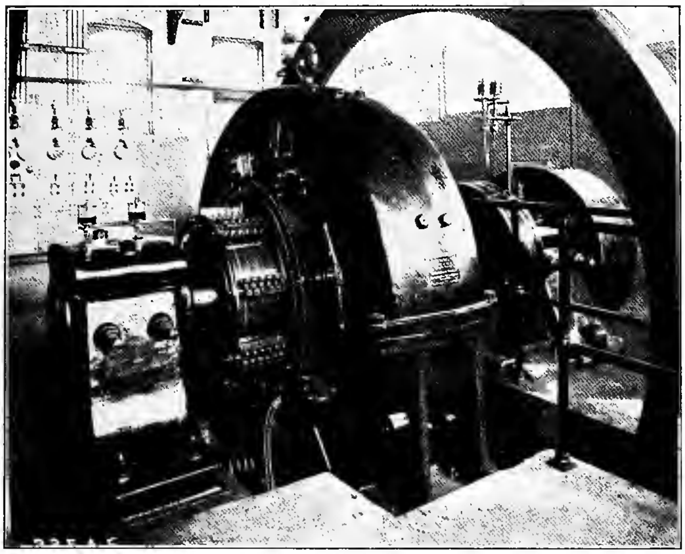
BOILER ROOM



BUFFALO FORGE CO.'S 54 IN. FAN DRIVEN BY A WESTINGHOUSE 10 H. P. TYPE S VARIABLE SPEED MOTOR

considerable manipulation to operate without any definite knowledge of intermediate speeds.

An illustration of the foregoing remarks is found in the plant of the Grand Rapids Pulp and Paper Company at Grand Rapids, Wisconsin. The mills are located on the Wisconsin River about four miles from the town, where an abundance of water power is available. This company strongly advo-



WESTINGHOUSE 200 K. W. 220 VOLT DIRECT CURRENT GENERATOR DRIVEN BY A 22 X 36 IN. CORLISS ENGINE

cates the use of electric drive and fully realizes the many advantages derived from its use. The electrical equipment was laid out by Mr. V. D. Simons, general manager of the company, and installed under his direct supervision. There are many mechanical and electrical features of interest and the entire installation is an example of modern engineering practice.

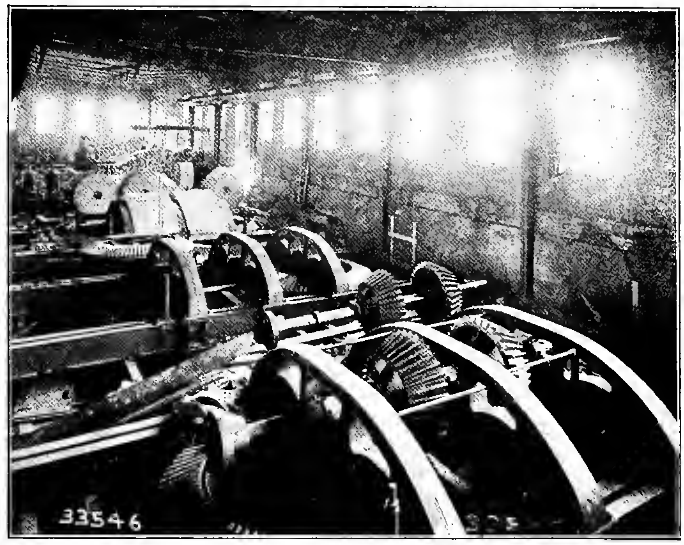
The pulp mill, where the stock is prepared for the manufacture of paper, is operated by water power, but the various processes afterward carried on employ electric drive.

One of the essential conditions of paper making is that as the weight or thickness changes the speed must be easily altered to provide for changes in the rate of production,

BEATER ROOM

which is usually accomplished by mechanical means. In the present case, however, the engineer accomplishes this result by the use of variable speed motors.

There are two Beloit paper machines, the smaller of the two having a capacity of 525 feet per minute, or a total of 21 tons per day, the width of the paper being 84 inches before and 78 inches after trimming. There are 29 dryers and a 70-foot wire. That portion of the machine which operates at variable speeds is driven by a 100 horsepower Westinghouse variable speed shunt wound motor with a speed vari-



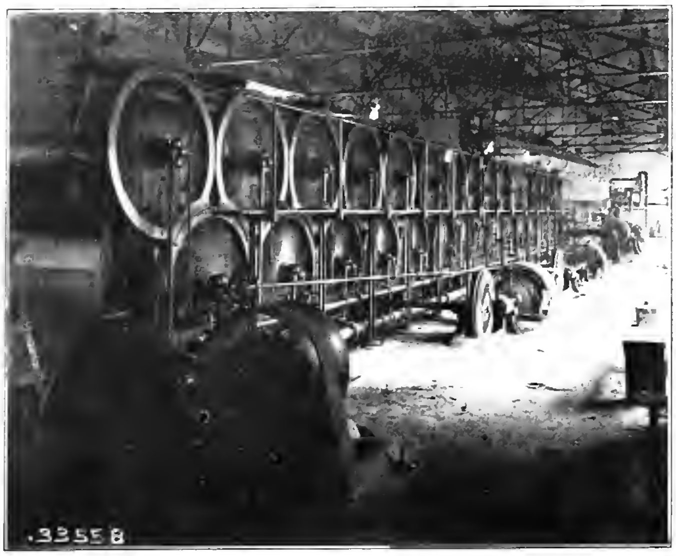
NEW PULP MILL SHOWING WATER WHEEL CONSTRUCTION IN FOREGROUND

ation of 470 to 750 revolutions per minute, which is obtained by field control. The actual power required, as shown by tests, to drive the variable speed portion of the machine under normal working conditions, i. e., 525 feet per minute, is 101 horsepower. That portion of the machine which operates at constant speed is driven by a 50 horsepower Westinghouse type S motor.

The larger machine has a capacity of 26 tons of paper per day at the rate of 475 feet per minute, 104 inches wide before and 97 inches after trimming, and is provided with 25 dryers and a 60-foot wire. The variable speed portion is driven by a 100 horsepower Westinghouse direct current shunt wound motor with a speed variation ranging from 470 to 750

BELOIT PAPER MACHINE TURNING OUT 500 FT. OF 104 IN. PAPER PER MINUTE

revolutions per minute, obtained by field control. Actual power determined by tests to drive the variable speed is 97 horsepower. The constant speed portion is driven by a 50

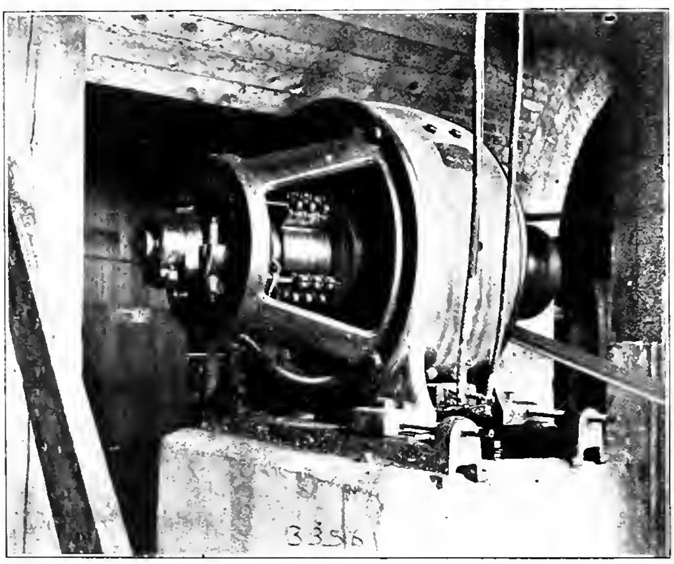


BACK VIEW OF PAPER MACHINE SHOWING METHOD OF DRIVING FROM BENEATH THE FLOOR

horsepower Westinghouse type S motor. The use of shunt-wound motors permits the use of field control which has the advantage of high efficiency and good regulation throughout its range.

In the cutter room there are two cutters and an elevator operated by a 10 horsepower Westinghouse type S back-geared motor. An interesting feature in connection with this motor is that it replaced 250 feet of 3 7-16-inch line shaft.

A 10 horsepower Westinghouse, driving a fully equipped

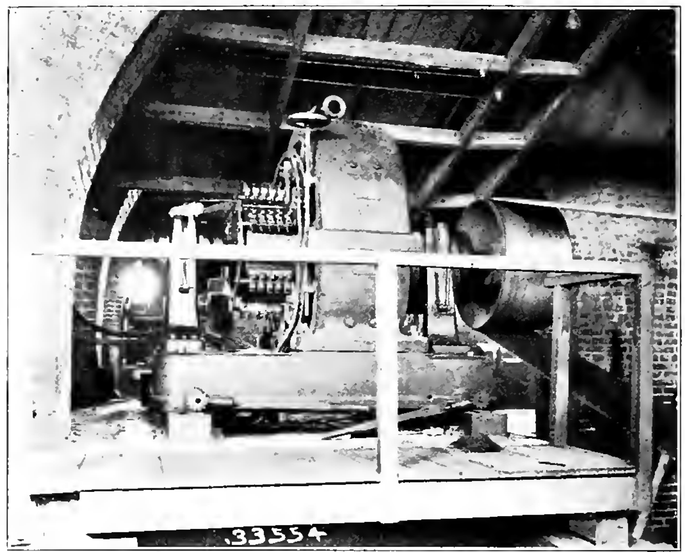


WESTINGHOUSE 50 H. P. TYPE S MOTOR OPERATING CONSTANT SPEED OF 104 IN. PAPER MACHINE

machine shop for general repair work completes the electrical equipment.

The present daily average output of this company is 45 tons of newspaper.

The boiler plant consists of four return tube units 72x16 inches, equipped with American underfeed stokers. The furnaces are the Dutch-oven type, arranged for burning refuse wood and screening coal. A 54-inch Buffalo Forge Company's fan, operated by a Westinghouse 10 horsepower type



WESTINGHOUSE 100 H. P. VARIABLE SPEED MOTOR OPERATING VARIABLE SPEED OF PAPER MACHINE

S variable speed motor, furnishes forced draft.

The generator equipment consists of one Westinghouse 200-kilowatt, 220-volt, engine type, direct current generator direct connected to a 22x36-inch Corliss engine operating at 125 revolutions per minute, and one Westinghouse 150-kilowatt generator of the same characteristic, belted through a countershaft to a water wheel. The rated speed of the generator is 600 revolutions per minute, and it operates in parallel with the engine-driven machine.

BELOIT PAPER MACHINE

An interesting feature in the regulation of the water wheel is the arrangement for controlling the gates. They are operated by a Westinghouse series wound reversible back-geared motor, started, stopped and reversed by means of a double push button on the switchboard. There is also an attachment on the governor of the engine for automatically controlling the motor, thus regulating the respective loads of the two generators.

The switchboard is of standard Westinghouse construction and consists of two generators and three feeder panels.

NEWS NOTES

TELEPHONES.

Farmers' Telephone Company has completed its line to the Badger Pocket country, 17 miles east of Ellensburg, west of Spokane. The line is 35 miles in length, and six trunk wires serve the subscribers.

The Interstate Telephone Company has just completed the installation of its system at Coeur d'Alene, Ida., east of Spokane, where its board has capacity for 500 lines, which will be doubled before the close of the year. J. W. Fisher is manager.

The Nez Perce Co-operative Telephone Company, operating at Ilo, Ida., south of Spokane, will improve its lines. The building of an extension from Dublin to Lawter's Canyon and the construction of a branch line from Nez Perce was authorized.

The Rocky Mountain Bell Telephone Company has granted increases to its operators at Wallace, Ida., east of Spokane. Beginners are paid at the rate of 10 cents an hour, and in three months this is raised to 16 cents. The new scale practically means an advance of $5 a month.

Members of the town council of Davenport, Wash., west of Spokane, unanimously voted down the application of John Nichols and others for a franchise for a second telephone system. The present system, known as the Farm and City Telephone Exchange, is controlled by J. A. Hansen, and is giving service all over Lincoln and Stevens Counties.

The government telephone line, paralleling the Sunnyside irrigation canal in the Yakima district, west of Spokane, has been completed. Eight patrol houses, for the use of riders, have been erected at 15-mile intervals, seven of these being equipped with instruments. From the head office at North Yakima lines will be built to each construction camp along the Tieton canal route.

Arrangements have been completed by the Pacific States Telephone Company for the installation of an automatic system to take the place of the town exchange at Pomeroy, south of Spokane. A new switchboard will be put in also, to better accommodate the increasing demand. The town exchange was installed in 1904, when 11 instruments were put in as an experiment. Now there are 200 instruments in use, besides the farmers' line, which utilizes 100 instruments.

Word has been received in Spokane that the government is making arrangements for the construction of a number of telephone lines in northwestern forest reserves. One of these will be in the Bitter Root reserve, in Idaho, east of Spokane, to the line running from Kootenai to the forks of the Clearwater River, 25 miles. The line will not only facilitate the work in the forests, but will play an important part in catching fires before they gain much headway.

Spokane, Wash.—Fifty thousand dollars will be expended by the Home Telephone Company of Spokane on a building to be used as a substation. The company will erect two substations and a main exchange, the entire cost being $200,000, exclusive of equipment. John T. Huetter, contractor, has begun work on the foundation for the main exchange, and the structure will be rushed. W. W. Hindman, attorney, who is associated with Cyrus Happy, vice-president of the company, announces that 4,000 instruments will be in operation Dec. 1, 1907.

TELEPHONE CONSTRUCTION.

Hoquiam, Wash.—Independent Tel. Co. began construction in this city May 20th.

Helena, Mont.—Western Union Tel. Co. has started work of placing wires underground.

Ferndale, Wash.—Farmers' Tel. Co. is setting poles to connect with Home Tel. Co. of Bellingham.

Hood River, Ore.—The Pacific States Tel. Co. will improve its system here with modern apparatus.

Portland, Ore.—Pacific Tel. & Telegraph Co. is laying new submarine cable under Willamette River at Washington Street.

Red Lodge, Mont.—Stillwater Co-operative Tel. Co. has completed 150 miles of rural line, and will build 80 miles additional.

Seattle, Wash.—U. S. Government will establish wireless telegraph station on Smith Island, opposite entrance to Straits of Juan de Fuca.

Butte, Mont.—Rocky Mountain Bell Tel. Co. is erecting a new building, 98x45 feet, to cost $85,000, to be finished August 1st; capacity, 11,500 subscribers.

Corvallis, Ore.—The Home Tel. Co. is constructing a trunk line from Corvallis to Peora. The line from Portland to Corvallis will be completed about June 15th.

Seattle, Wash.—N. P. Ry. Co. has been granted temporary injunction against the Home Tel. Co. from setting its poles on N. P. right of way. Hearing May 28th.

Monida, Mont.—Centennial Tel. Co. has let contract to Wm. Patt of this place for about 50 miles of line from Monida to Lakeview, to be completed September 1st.

Waitsburg, Wash.—Changing the lines of Waitsburg Rural Tel. Co. to offices of Pacific Tel. & Telegraph Co. is now going forward, the above named companies having consolidated.

Spokane, Wash.—Supervisor of Forest Service has been authorized to construct 25 miles of line from Kootenai to forks of Clearwater River, in Idaho, and from Parsons to Three Rivers, in New Mexico, 14 miles.

Bend, Ore.—Deschutes Tel. Co., of Bend, and State Central Tel. Co., of Prineville, will reorganize and consolidate with capital of $150,000. Lines will be constructed from Prineville to Burns, and Prineville to Silver Lake. New line from Prineville to Paulina is being pushed, about 40 miles being now completed.

NATIONAL ELECTRIC LIGHT ASSOCIATION.

The 30th convention of the National Electric Light Association will be held June 4, 5, 6, 7, at Washington, D. C. The preliminary program gives promise of a most interesting and instructive meeting, including both social and business features. Technical papers are to be read by some of the best known engineers in the country.

POWER AND LIGHT PLANTS.

Lind, Wash.—H. Warner is negotiating for an electric light franchise.

Colfax, Wash.—Council will purchase two pumps and a gasoline engine for water plant.

Granite Falls, Wash.—A new wheel has been put in by the electric company which increases the power by about 50 horsepower

Georgetown, Wash.—Seattle Lighting Co. proposes to remove its gas plant from Jackson Street, Seattle, to this city if a franchise can be secured.

Oroville, Wash.—Col. A. M. Dewey, who is promoting an electric railway project for this territory, is building a power plant at Simikameen Falls.

Moscow, Ida.—The Idaho-Washington Light & Power Co., of Moscow, capital $500,000, succeeds the Moscow Light & Power Co. Company controls eleven plants in these two States.

North Yakima, Wash.—Work has commenced on the new building to be erected by the Northwest Light & Water Co., on Second and A Streets.

Tacoma, Wash.—A municipal light plant, to furnish 5,000 horsepower of electricity, and to cost $50,000, will be submitted to the Council and probably to the people.

Great Falls, Mont.—Two hundred feet of the steel trestle which supported the bar line from the power house to the electrolytic plant at the Boston and Montana smelter, collapsed.

Nelson, B. C.—The fight between the city of Nelson and the West Kootenay Power & Light Co., which has waged for seven years, has come to an end. The city will now supply its own light.

Lewiston, Ida.—The Oxbow Electric Co. is driving three tunnels across the oxbow of the Snake River and will install a plant to develop 2,500 horsepower for irrigation and power for mines.

Red Lodge, Mont.—The Northwestern Imp. Co., which is opening up extensive new coal mines near town, will install a second electric power house at the mine and add much new machinery.

Olympia, Wash.—The fight for the water right at Tumwater Falls has been decided by the Supreme Court in favor of the Olympia Light & Power Co., Leopold Schmidt losing the right to use the greater amount of the Des Chutes waters.

MEETING NOTICE

At a recent meeting of the Association of American Portland Cement Manufacturers, in Philadelphia, there was considerable discussion on the subject of concrete paving, the gist of which is published in Bulletin No. 14, including "Concrete Roadways," by H. L. Weber, and "Cement Concrete Roads," by Walter E. Hassam. Mr. Hassam's definition of a perfect road—a highway sanitary, durable, noiseless, dustless, smooth without being slippery, easy to repair and built at a cost that will appeal to the taxpayer—has been met by concrete. Stone and cement and the heavy roller have made it possible to build what is practically a highway of solid stone, a monolithic mass fully capable of resisting modern traffic for many years. Concrete Bridges are discussed in Bulletin No. 15.

TELEPHONE AND TELEGRAPH.

Ely, Nev.—E. H. Harrison, manager of the Utah and Nevada Telephone Company, a branch of the Rocky Mountain Bell Telephone Company, sends news that his company will begin immediately the construction of its proposed telephone line from Salt Lake to Ely. Contracts have been let for building the line in sections.

Greenville, Cal.—There is a movement among the stockmen of the Lassen Peaks Forest Reserve to secure the permission of the Federal Government to build connecting lines from the different camps of the stockmen to the line which the Government is going to establish through the reserve. Head Forester J. C. LaPlant has been consulted by many of the stockmen, and those of Payne's Creek have agreed to pay the cost of construction of a line if it can be arranged. It is the plan to build a connecting line through the Lassen Reserve to Red Bluff. The Government has planned to connect its phone line with Quincy and Susanville.

San Francisco, Cal.—The completed plans for the main building of the Home Telephone Company have been received. The structure will equal in architectural distinction any of the business houses in the locality. It will be of Class A construction, six stories in height, with basement. The type of the building is classic, and the order Corinthian, superimposed on a rusticated two-story base. The exterior will be of white sandstone. It is planned to complete the structure early in 1908, if labor conditions will permit. The site has a frontage of 63 feet on Grant Avenue and 130.5 on Harlan Place, an area between Bush and Sutter Streets. The officials of the Home Telephone Company report progress in the installation of their underground wire system, and expect to be ready to serve customers by the time the new building is completed.

Reno, Nev.—J. G. Blake, assistant general superintendent of the Postal Telegraph and Cable Company, was here recently after a trip to Ely, Tonopah, Goldfield and Bullfrog, where he has been looking over the proposed route of the Postal lines through Nevada to San Francisco. Mr. Blake has entire charge of the work in Nevada and was in Reno to consult with Engineer T. J. Stewart, who will supervise construction work in the State. Together they will prepare a report on the route chosen, to be submitted to Clarence Mackay and other officials of the company early in June. In speaking of the route, Mr. Blake said: "As near as we can tell now, the line coming from San Francisco will pass through Reno, and then into the Southern country, passing through Goldfield, Tonopah and Bullfrog to Ely, and from there to Salt Lake. Topography will determine the route, and the main line may pass a few miles outside of Reno, but our best offices will be installed here."

WATERWORKS.

Redding, Cal.—Six carloads of wooden pipe for water mains have been received from Tacoma. The pipe is for the enlarged system which the Redding Water Company has under construction—a system that will serve a part of the city not hitherto covered, and that will give a much better pressure throughout the city for fire purposes. The chief engineer predicts that the enlarged system will be completed by August 1. An entirely new pumping station is being built on the banks of the Sacramento River, a mile above the city. The excavation for the foundation is completed, and the cement foundations for the heavy pieces of machinery, pumps, motors and transformers, are being laid. The improvements to the waterworks will cost $60,000. Wooden mains, instead of iron mains, are being used in the western part of the city, because it has been found that there the sulphur carried in the soil waters attacks the metal and destroys the usefulness of the pipes. In other parts of Redding sulphur water does not appear, and there iron pipe gives satisfaction.

INCORPORATIONS.

San Luis Obispo, Cal.—The Lagunitas Oil Co. has been incorporated, with James Taylor, W. F. Summers, A. C. McMillan and others as directors.

Los Angeles, Cal.—The Norton Engine and Power Co. has been incorporated with a capital stock of $25,000. The incorporators include W. R. Harvey, T. S. and H. K. Norton.

Roswell, New Mex.—The Portales Water Works and Electric Light Co. has been incorporated here with Coe Howard, W. H. McDonald and Jos. Howard as incorporators. The company intends to operate waterworks and an electric light plant at Portales.

Los Angeles, Cal.—The Angelus Oil Co. has filed articles of incorporation with a capital stock of $300,000. Those behind the project are M. V. Quigg, J. O. Downing, C. F. Seaman, R. C. Smith and M. S. Gregory.

Los Angeles, Cal.—The Marine Power and Electric Co. has been incorporated here with a capital stock of $1,500,000. G. H. Bancroft, E. C. Phipps, G. M. Wilson, W. J. Compton and R. M. Amous, of this city, are the incorporators.

San Rafael, Cal.—Articles of incorporation have been filed by the Chapman Water Co., of Corte Madera. The capital stock is placed at $75,000, shares $1 each. The directors of the concern are M. C., E. C. and A. V. Chapman.

Visalia, Cal.—The Elderwood Water Company has been incorporated with a capital stock of $50,000, shares $50 each. Those backing the proposition are C. H. Holley, J. F. Mitchell, H. B. McClure, J. W. Fewel, J. E. Barton, H. G. Parish and William Cowling.

OIL.

Bakersfield, Cal.—The Southern Pacific is said to be making arrangements to extend its pipe line, which now ends at Delano, up the valley to San Francisco, as soon as possible. It is expected that work will be begun next Fall. The line will probably be of eight-inch pipe.

Bakersfield, Cal.—The local fuel oil market has received another upward boost in the form of an offer made to the McKittrick Oil Company for a five-year contract for 25,000 barrels a month at 50 cents per barrel. The oil already contracted for by the Associated leaves the McKittrick Company with little surplus oil. S. W. Wible, manager of the corporation, has made inquiries among the neighboring producers, with a view to making up the amount required, but some of the other companies are inclined to hold out for still higher prices. A number of new wells will be put down by the McKittrick Company as soon as practicable.

McMinnville, Ore.—A large company of capitalists of Portland and The Dalles have signed a lease for three thousand acres of land in the North Yamhill gap. The lease is for ninety-nine years and the operations are to begin at once to bore for oil. The contract reads for "oil, minerals and coal," and the owners are to get ten per cent of whatever is found. If oil is not struck in eighteen months the lease becomes null and void and reverts back to the owners of the land. The company is well backed financially and very expensive machinery will be installed at once. The company contemplates putting in $20,000 or $30,000 worth of machinery at the beginning. It has had experts in the country examining the formation here and they say that it is exactly the same as is found in rich oil regions and predict that oil will be found in the leased acres.

ELECTRIC RAILWAYS.

Bellingham, Wash.—The Bellingham-Skagit Co. Interurban is soon to commence work on its new road.

Clarkston, Wash.—Jay P. Graves announced that the Spokane & Inland Railway is going to build into this place.

Portland, Ore.—The Rainier Electric Co. has been incorporated with a capital of $25,000, by Alex Sweek, Carleton Lewis, and W. C. Morris. The company will build an electric line from here to Rainier.

Eugene, Ore.—The Eugene & Eastern Railway Co. has been incorporated with a capital of $1,000,000, by A. Welsh, E. W. Hall, F. W. Waters, James R. Thompson and Charles A. Hardy. It will build lines from here to Prineville, and also from here to Corvallis.

Milton, Ore.—The Walla Walla Valley Traction Co. has filed with the city the route of the proposed loop which is to be on First Street from Main to Mill; on Mill Street from First to Union; on Union Street from Mill to Cherry; on Cherry from Union to Thorn, and on Thorn Street from Cherry to Mill.

Roseburg, Ore.—Stock amounting to $100,000 has been subscribed for the Coos Bay Electric R. R.

Tacoma, Wash.—W. S. Dimmock states that work will soon commence on the new interurban from here to Orting.

Vancouver, Wash.—The Washington Railway & Power Co. will soon commence constructing their street railway in this city.

ILLUMINATION.

San Jose, Cal.—Among the merchants here there has been passed around a contract for lighting other than the system now in use. Hugh Center appears as the contracting party of the first part. He is at present in the East.

Suisun, Cal.—Attorney T. T. Gregory has appeared before the Board of Supervisors with an application from E. D. N. Lane, of Dixon, for a franchise to erect poles and string wires for transmitting electricity for lighting, heating and power purposes along certain roads leading from Dixon to Rio Vista, and along certain other roads in Silverville, Elmira and Green Valley townships, with the authority to sell and dispose of the electricity. The sale of the franchise has been set for June 3, and bids for the same will be received on that date.

Reno, Nev.—This city is trying to solve the problem of better and cheaper street lights. Arc lights supported on ornamental poles located every fifty feet along Virginia Street from the Truckee River Bridge to Commercial Row, will be installed if the present plans of City Electrician Caffrey are carried out. He says in his annual report that the work could be completed in such a manner as to add to the attractiveness of Virginia Street, and that the plan would be a great advertisement for the city. Twelve thousand sixteen-candlepower incandescent lights were installed in the stores, offices and homes of Reno during the last fiscal year, according to the report of the official.

Los Angeles, Cal.—Property owners on Pico Street have filed petitions with the City Clerk asking for ornamental lights on their street, something like the electroliers on Broadway and Spring Streets. They also ask that all the electric poles be taken down and ornamental poles substituted.

NEWS NOTE

Yreka, Cal.—J. F. Wagner has filed on 3,000 inches of water of Cabin Meadow Creek for mining and domestic use.

TRANSMISSION.

Nevada City, Cal.—The Bay Counties Power Co. has commenced the construction of a line which is to carry electric power from the Rome power house on the South Yuba River, near Hoyt's Crossing, to the Alaska Mine, near Pike City. The line will be ten miles in length, and about twenty-five men, under M. M. Turner, have been engaged to put the work through. The company wants to have the line completed in about two months. The Alaska is a rich mine, but the previous operation of it with steam power was so costly that the profits were very small. A tunnel will be run to drain the mine. The power line under construction will probably be extended to Alleghany and Forest, where there is great activity in the mining developments and need of cheaper power and lights.

Oakland, Cal.—The Western Power Company has located a site for a power station here, which is to be one of the main supply headquarters on a line stretching from the Sierras to the sea. The company has purchased a large tract of land in East Oakland on Brooklyn Basin, and here the plant will be constructed. The site is on what is known as Sessions Basin, just east of the north arm of the estuary into Lake Merritt and adjoining the holdings of the American Magnesite Co., at the foot of Sixth Avenue. The site has been selected for the main distributing point for Oakland. The company has extensive plans for the development of its main source of supply, which will be located in the Sierra Nevada Mountains, not far from where the main line of the Western Pacific crosses the mountains through the Beckwith Pass. The enterprise is closely identified with the Western Pacific interests in New York City. At the head of the new company are Edwin Hawley and other representative capitalists who are concerned directly with the Gould railway development. It is declared by those who are informed concerning the new company's movements in Oakland that the Western Power Co. proposes to compete with the Standard and Bay Counties Companies, and to extend and parallel one or both of those lines.

FINANCIAL.

Los Angeles, Cal.—The reorganization of the Pacific Lighting Corporation, of Los Angeles and Eureka, was effected last week by the filing of articles of incorporation by which the capital of the corporation is increased to $20,000,000, of which $10,000,000 is in preferred stock and the rest in common. In the new articles Alfred Sutro, C. O. G. Miller, George F. Voltman, Charles Holbrook and G. H. Collins are named as having subscribed for one $100 share each. Alfred Sutro says that the business of the company had increased to such an extent that it was thought advisable to enlarge its scope. Operations are not contemplated in San Francisco.

Los Angeles, Cal.—A new electric railway line connecting Santa Ana with Newport Bay, a city at the new tidewater to be called Port Orange, extensive terminal facilities and improvements contemplating connection with the three transcontinental lines, and the early opening of a free harbor, are a few of the things foreshadowed by the articles of incorporation of the Port Orange and Santa Ana Railway Co. The incorporators are Frank M. Johnson, Walter G. Hopkins, A. F. Lijeal, Joseph M. Fletcher, Eugene Germain, Mark L. Germain, C. L. Fredericks, Harry P. Vanderveer and G. H. McCarthy. The capital stock is $500,000, and the amount subscribed $50,000. The railroad will be a broad-gauge electric line, and will be the last link by rail between the sea and a population of 150,000, exclusive of Los Angeles, distributed among the cities of Southern California. The city of Santa Ana is to be the connection between all the cities of the southern part of the State and the harbor at Newport Bay. Nearly all the material for the new line has already been purchased, and work on construction will commence at once.

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WITH WHICH IS INCORPORATED

The Engineers', Architects' and Builders' News

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THE

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The Engineers', Architects' and Builders' News

VOLUME XVIII. SAN FRANCISCO, CAL., JUNE 8, 1907 No. 23

Kern River Station No. 1 of the Los Angeles Edison Electric Company

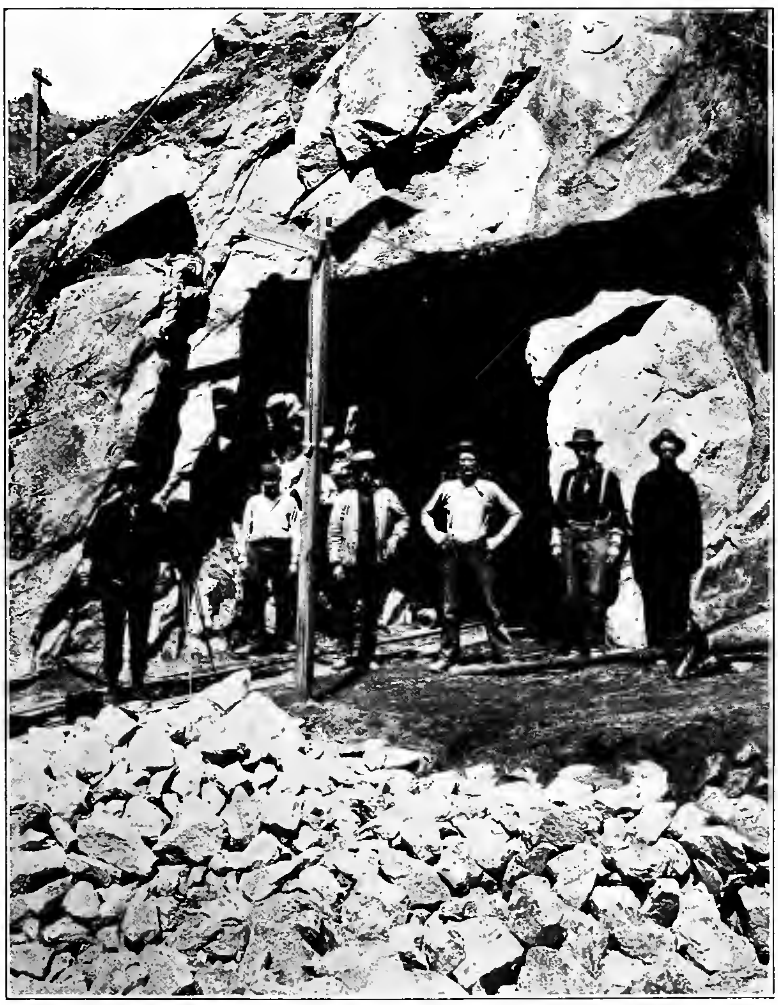
(Continued from June 1.)

Owing to the nature of the mountain where the tunnel emerges above the power house, no terminal reservoir could be excavated, so a fore-bay, 30x40 feet, was cut to a necessary depth below the grade of the supply tunnel, with controlling gates, and screens over the mouth of the force main.

Retaining walls were made of sufficient height to prevent material from the mountain above, from entering the fore-bay. On the lower side where the wall was unsupported it was made sufficiently heavy to withstand the water pressure on the inside of the fore-bay. The water enters the force main from the bottom of the fore-bay from opposite directions, thus preventing any formation of eddy or whirlpool currents.

A spillway, the height of which can be controlled by means of flash boards, was constructed on one side, leading to the waste conduit, extending down the mountain side and discharges into the Kern River, 600 feet above the power station. This conduit is of concrete at the upper end, and terminates in a redwood flume down the 45 deg. grade of the hill.

The construction of the force main is the most unique and interesting piece of engineering in the system. Instead of laying steel pipe on the surface or burying it only deep enough to prevent external injury, it consists of an incline tunnel driven through the mountain. This tunnel begins in the bottom of the fore-bay, and runs through the mountain, as shown by the cut, and emerges at the lower end on a level with the floor of the power house station.



PORTAL OF TUNNEL NO 5, KERN RIVER

The force main starts with a diameter of 9 feet, tapering for 20 feet to a diameter of 7½ feet, which it maintains for 1,172.3 feet. At this point the force main tunnel emerges from solid rock to a detrital deposit lying between the mountain and the power house, through which a tunnel was driven to its emergence at the power house, a distance of 252.7 feet.

The upper end of the tunnel in the solid rock was lined with steel plates, 3-16 inch thick, riveted together in the form of pipe 7½ feet inside diameter. The steel pipe was put in in 10-inch sections, the space between the steel pipe and rock being filled with a mixture of concrete, three parts sand, three parts crushed rock, and one part Portland cement. The installation of this lining was begun at the lower end where it passes through the 252.1 feet of detritus, at which point a taper of 1⅛-in. steel plate, to withstand the static pressure without external support. No concrete was placed around this pipe, and the terminal was left with the timber sets to support the ground overhead.

The steel plate was riveted together with both straps placed in solid rock, reducing the diameter from 7½ feet to 5¼ feet.

From the end of this section of pipe the header pipe was run, with the following lengths and diameters:

For 33.5 feet, 4¾ feet pipe; for 23 feet, 4¼ feet pipe; for 21 feet, 3¾ feet pipe; for 11.5 feet, 3 feet pipe; for 16.7 feet, 2 1-3 feet pipe at end.

These diameters are graduated to maintain uniform velocity after withdrawing the water in various branches to

supply the water wheel units in the power house.

In reducing the force main at its various pipes to meet the diameters given, taper pipes as follows were used:

1 taper 7.5 ft. diam. to 5.25 in. diam. 20 ft. length
1 taper 5.25 ft. diam. to 4.75 in. diam. 10 ft. length
1 taper 4.75 ft. diam. to 4.25 in. diam. 10 ft. length
1 taper 4.25 ft. diam. to 3.75 in. diam. 10 ft. length
1 taper 3.75 ft. diam. to 3.00 in. diam. 10 ft. length
1 taper 3.00 ft. diam. to 2.33 in. diam. 10 ft. length

From the force main, the branches were taken out at right angles to the rear wall by means of a Y on the header pipe. Each branch for the water wheels has 28-inch inside diameter, and each branch for the exciters has a diameter of 10 inches.

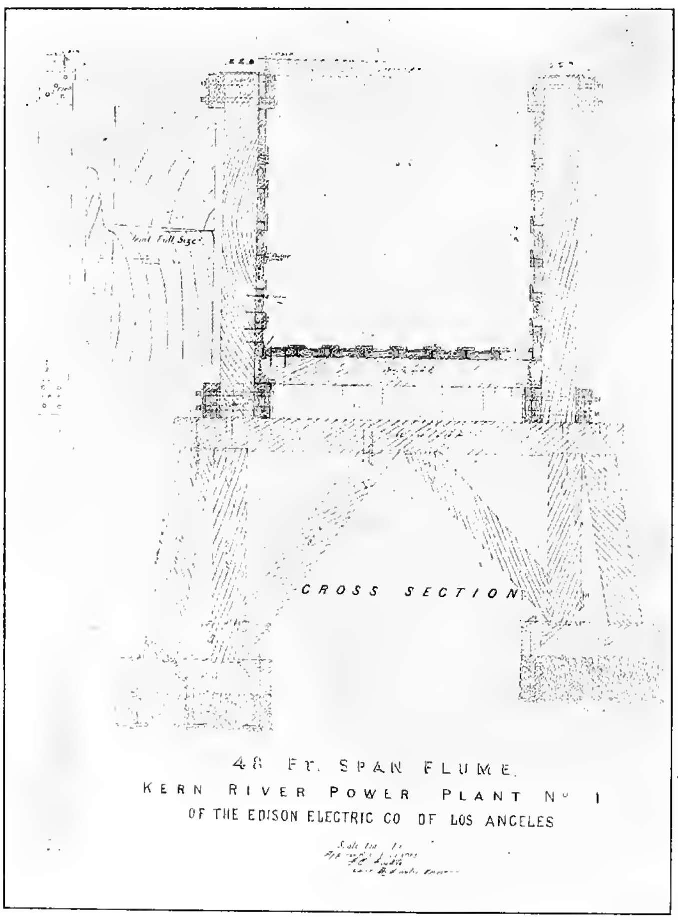
The water is projected on the buckets of the impulse wheels through deflecting nozzles with needle valves by means of which the discharge of the tip can be regulated without disturbing the form of the jet.

There are eight impulse wheels, each having eighteen 27½-inch buckets bolted to the rim. One wheel is mounted on each side of the generator.

The four big impulse wheels which convert hydraulic to electrical energy, have each a capacity of 10,750 horsepower at full gate, and a speed of 250 revolutions per minute, when operating under a net effective head of 865 feet. In addition to the main turbines there are two exciter turbines, also of Allis-Chalmers design, each with a capacity of 450 horsepower, and a speed of 430 revolutions per minute.

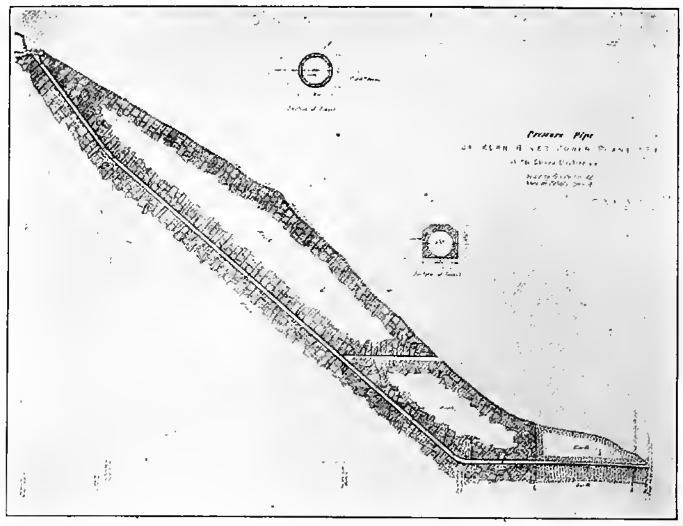
Automatic regulation is effected by means of oil-operated hydraulic governors.

The combined moment of inertia of the revolving ele-



FLUME CROSS SECTION.*

ment in the water wheels and generator is 1,800,000 ft. sq. lbs. by means of which regulation at 100 per cent load variation



PRESSURE PIPE OF KERN RIVER POWER PLANT NO. 1.

is obtained within less than 8 per cent when the units are carrying 50 per cent overload and within less than 5 1-3 per cent variation of speed when running at normal load.

There are a number of concrete conduits connecting some of the tunnels and flumes. The interiors of these conduits are of the same dimension as the flumes. They are made of reinforced concrete with steel arches, covered with a cushion of earthen material to receive the impact of anything rolling or sliding down the hill and passing over the conduit.

The following table gives the number and length of each conduit:

Number of Conduit.	Feet. Length in
1	100.00
2	69.4
3	6.2
4	42.2
5	40.0
6	92.5
7	31.6
8	121.6

The concrete which entered largely into the construction of this plant was made from one part by volume of hydraulic cement, five parts broken stone, and three parts of sand. The broken stone, crushed to pass through a 2-inch ring, was made from tunnel waste deposited at the portal of each tunnel, and as there was little sand in the river, nine-tenths of the sand was made from the tunnel waste by passing crushed rock through sand rolls. The concrete was mixed by power mixers at the tunnel portals.

A construction plant, generating 300 kilowatts, was installed for furnishing power for driving tunnels, mixing concrete, transporting materials, also for lighting the tunnels and camp quarters.

This construction plant was developed by means of a flume 800 feet in length, supplying water to McCormick reaction turbines, operating one 150-kilowatt generator for each turbine. It was abandoned after the completion of the main plant.

All the methods of construction were among the most modern of engineering practice. As has been said before, electric power was used for handling the concrete, for lighting, and for compressing air.

The normal rated capacity of the plant is 20,000 kilowatts, or 26,667 electrical horsepower. The machinery is all tested to operate under 50 per cent overload for peak load service, thus making the ultimate capacity 30,000 kilowatts, or 40,000

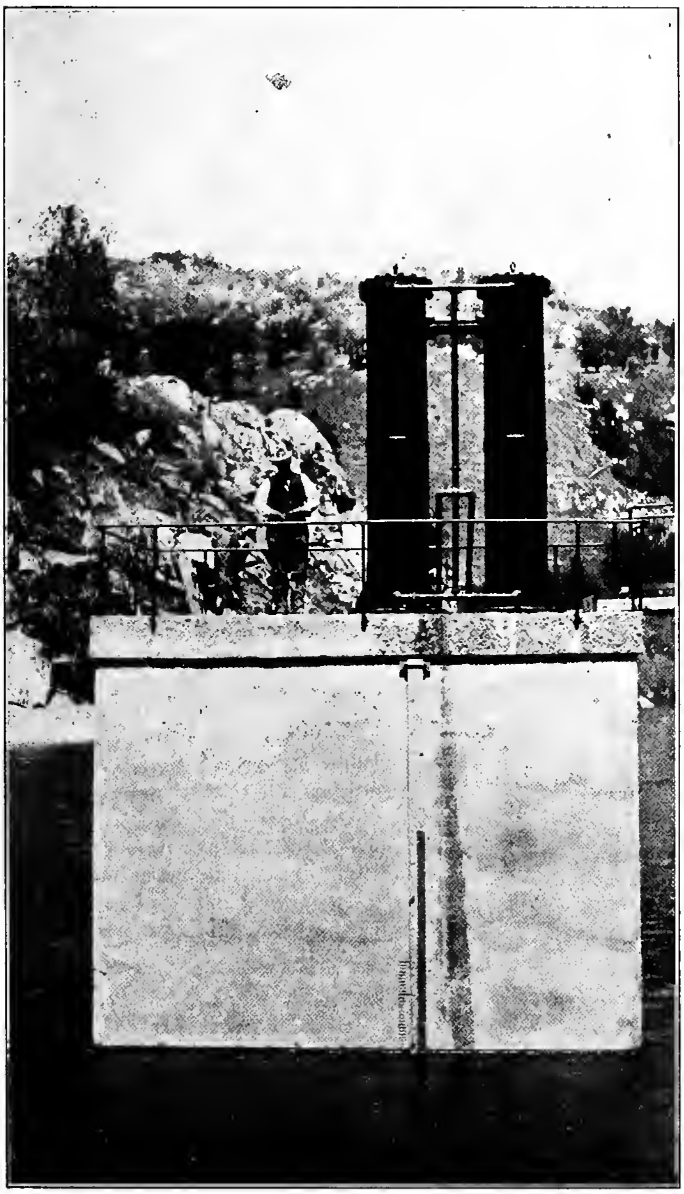
*Owing to reduction of drawings the dimensional scales are not correct.

electrical horsepower.

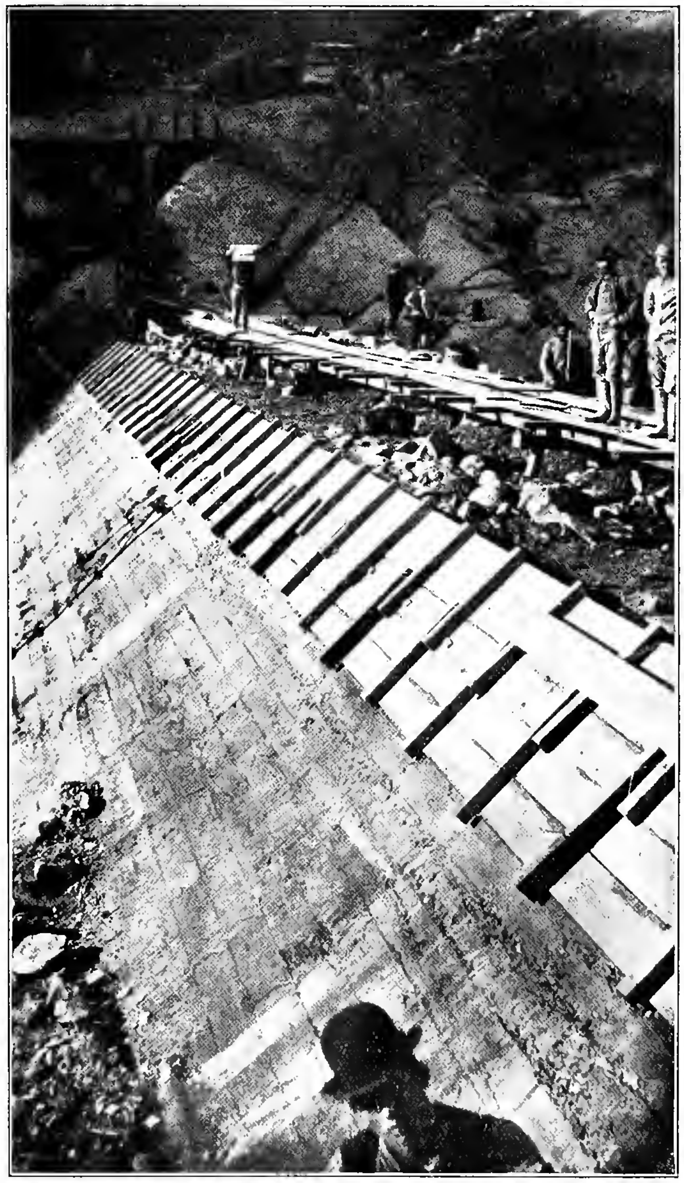
The space chosen as the power house site was directly in front of the point where the pressure tunnel emerges from the hill-side, at an elevation of 1061.95 feet. This point was chosen in order that the elevation of the pipe line and of the water wheels be sufficiently high to permit the running of the units when the Kern River was at its maximum flood.

The foundations were started on bed-rock and cemented boulders, low enough to avoid any possibility of the power house being undercut by floods, and were carried up as walls in such a manner that no important machinery rested on floors placed on back-fill. Back-fill from other portions of the work was used to fill spaces between these walls which could not be utilized on account of their falling so low as to be subject to floods.

A deep excavation in the hill-side had to be made to accommodate the inner end of the building, the debris from this cut and from the tail-races was wasted on one side of the building as a dump. Upon this dump was placed a continuation of the pressure line from the machine's Y, and on the other side the spoil-bank was thrown as a bulkhead to protect the power house against possible flood.



CYLINDERS CONTROLLING GATES



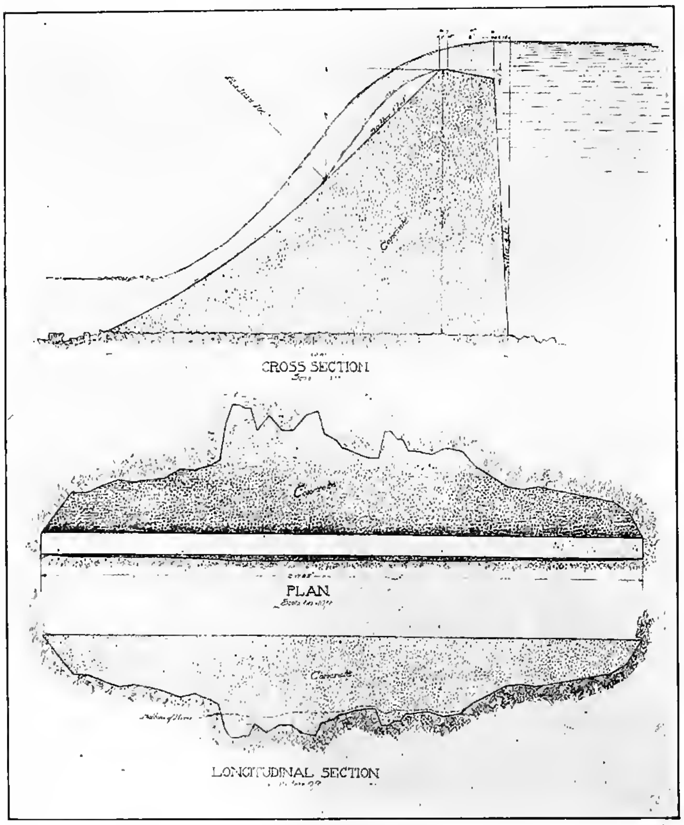
CONSTRUCTING DAM

A small amount of reinforcement is carried upon the upper part of the machine foundations. The large masonry block back of each water wheel deflector is reinforced heavily and tied into the main foundation blocks. Excepting the long span above the switch-board, which contains an I-beam girder, the crane rail arches for the interior walls are reinforced concrete beams. Because of the great length of the building and the importance of the work, no account was taken of the additional strength resulting from the continuity of the beams, the bridging effect of the crane rail, nor its cushioning timbers, nor was any allowance made for the 12-inch curtain walls, which in places fill in below the beam. The north wall, however, a 12-inch curtain wall reinforced with heavy pilasters, contains only enough reinforcement to give reasonable security against vibration and shock. For about two-thirds of its length the south wall of the building is of cellular construction, producing wiring ducts for the 60,000-volt connection. The reinforcement of this wall is nominal. A series of transverse partitions between the south and the interior crane walls divide the space into switch, switchboard, and transformer rooms, the last of which are open to the crane beam, making it possible to wheel the transformers out and under the main crane. The crane rail columns are not highly stressed, and they have no hooping. The control board is mounted upon a deck carried 8 ft, 6 in. above the main floor level in the switchboard space. The internal length of the machine room is 164 feet. The roof is made of galvanized iron, laid on wooden purlins, carried on steel roof trusses of 52 ft. 1 in. clear span.

Before entering the building branches are taken off for

each nozzle from the steel pressure pipe Y branches, which pass through a 28-inch cast steel hand-operated gate valve, then across and beneath the transformer house. A short distance before joining the machine nozzle bases they are connected to a more elaborate valve, of a similar type, but operated by an electric motor. This second valve operates in about seven and a half minutes. Both valves are fitted with 4-inch by-passes.

When work was commenced on Kern River No. 1, no plant of equal size had been constructed for impulse wheel work; units exceeding 2,000 kilowatts in output were rare, and at first it was thought that 2,500 kilowatt units would be selected for the station. But many large units were operating successfully by the time specifications were issued, and bids were asked on machines of 4,000 and 5,000 kilowatt normal output. Generators of this size were secured without difficulty. Although some factories were ready to build wheels having an output of 10,000 horsepower, each from a



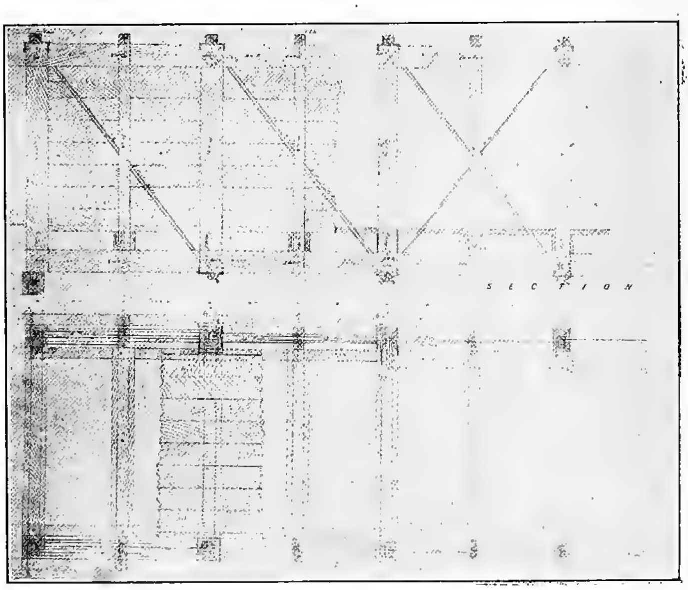
DAM SECTIONS

single nozzle, their great size and the crowding of the buckets which would be necessary to reduce the dimensions of the unit within reasonable limits, indicated that a more efficient arrangement would be that finally adopted—two single nozzle wheels for each generator, one wheel overhung on each end of the generator shaft. At full output each nozzle throws a 7⅜-inch jet. They are of needle type, deflecting, operated by governors midway between them on their common rock shaft, below the main floor line and accessible through a longitudinal shaft alley 5 feet wide with a clear head room of 7 feet. The needles are straight-backed, each running through a guide sleeve of its full diameter into a balancing chamber, supplied with water from the pressure side. The needle, reducing to a stem, passes through a second stuffing box, and beyond this the control links are attached. This arrangement gives convenience in construction, and permits of balancing the needles for back-thrust. So that the needle stem may be brought out without offsetting the nozzle and throwing a side strain on the ball joint bearings, the nozzle casting is bifurcated. The needle stems and some tips are of steel, but some cast iron tips which are being used are expected to wear as well as those of steel.

STEEL AND CONCRETE FLUME

Fastened with bolts to the cast steel rim of each wheel are eighteen bronze buckets, much like modern buckets in use elsewhere on the Coast. Before the wheels were constructed the company's engineers carefully checked their mechanical and hydraulic design. The efficiency guarantee, which is to be substantiated by the company's tests, requires that the water wheel proper shall develop an efficiency at rated load of 82½ per cent. Dead water leaving the wheels flows down the floor to the wheel race into the main tail race. Live water deflected past the wheel by deflecting the nozzle passes over a pair of heavy metal deflector plates, and is killed before it reaches the main tail race. On both sides the wheel races are lined with steel. To keep splash out of the shaft alley they are fitted with a steel back plate. The wheel cases are made of cast iron, are of graceful form, and fitted with compound baffles to prevent water from cropping out of them along the shaft. Enough space was left between the two exciters to allow the insertion of a large induction motor if it became necessary. The motor would be designed for a good speed regulation and connection by a pair of clutches to either one of the exciters. The governors are self-contained, oil-actuated, have their pumps immersed in their oil reservoir, and are driven by a silent chain from the generator shafts.

Each main unit is carried on two 16-inchx48-inch babbitted bearings, each bearing fitted with six oil rings for flooding them with oil for cellars contained in their pedestals. The oil is cooled in the pedestals by water coils, built into them. In the lower portions of the bearings are numerous small openings connected to a triplex power-driven



FLUME SECTIONS

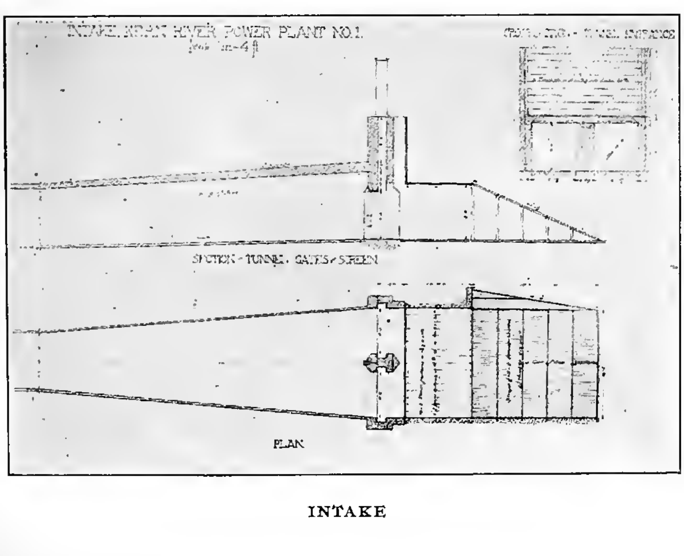
DIVERTING DAM AND INTAKE, KERN RIVER POWER PLANT No. 1

pump, capable of supplying oil at a pressure of 1,000 lbs. per square inch.

At both ends the shaft flares, forming a flange to which a wheel disc is bolted. At the center it is enlarged to carry the cast steel pole rim and spider, a single casting weighing 26 tons. To the exterior of this rim are wedged the pole pieces.

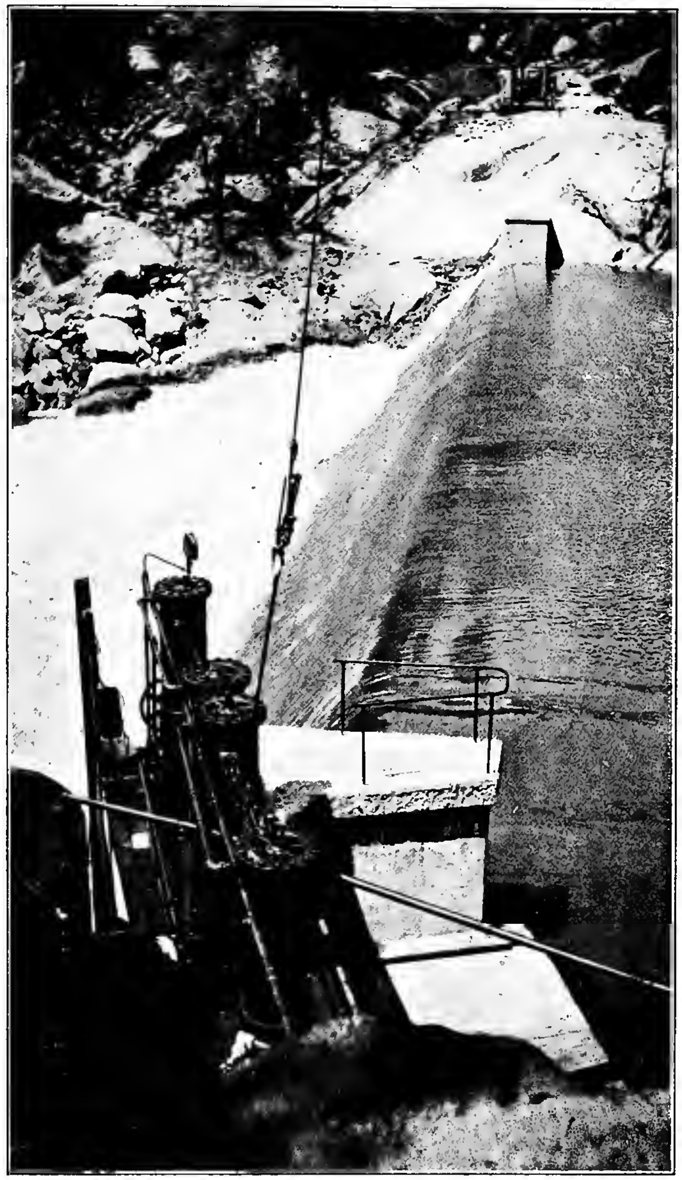
The generators have no unusual features. Their stationary armatures are bar wound for 2,300 volts, three-phase. The exciters are two-bearing, with a water wheel on one end and a fly wheel for close regulation on the other. These units are standard direct-current machines, generating at 125 volts, flat compounded, running at 430 revolutions, and fitted with ordinary self-adjusting bearings. They were furnished by the General Electric Company.

In the station are thirteen transformers, 1667 kilowatts, oil-filled, shell type, oil-circulated, in boiler-iron cases. They are grouped in four banks to receive energy at 2,300 volts delta from the machines, and to supply it to the line at 75,000 volts Y. Taps are provided for intermediate voltages of 56,250 and 37,500. Instead of having internal water cooling coils, the transformers are so constructed that oil supplied to them under a slight pressure automatically distributes throughout the windings, and returns by gravity to the waste pipe. The piping and connections for this circulation, consisting of a 4-inch supply line, a 6-inch return line, and a 4-inch waste, are in the basement of the power



INTAKE

house. Coming from the transformers, the oil enters a receiving drum, from which it is drawn by two 5-inch centrifugal pumps, motor-driven by variable speed direct-current motors. In an emergency, either pump can supply the station. The oil is forced by these pumps through a set of boiler tube coolers with a total area of 4,500 square feet, returning from these to a pressure line which supplies the transformers. Strainers, by-passes, and other auxiliaries are so placed that the entrance of foreign matter into the oil cannot cause trouble throughout all the banks. The system is under pressure from the time the oil enters the pump. Any leakage will, therefore, be outward, and there is no possibility of the leakage of water into the oil, as is the case



INTAKE DAM AND GATES

where water coils under pressure are placed in oil-filled transformers. The installation cost of such a system is less than that of a similar installation using water cooling. Water for the cooling sections is by-passed from one of the exciter tail-races into a flume built across the top of the coolers.

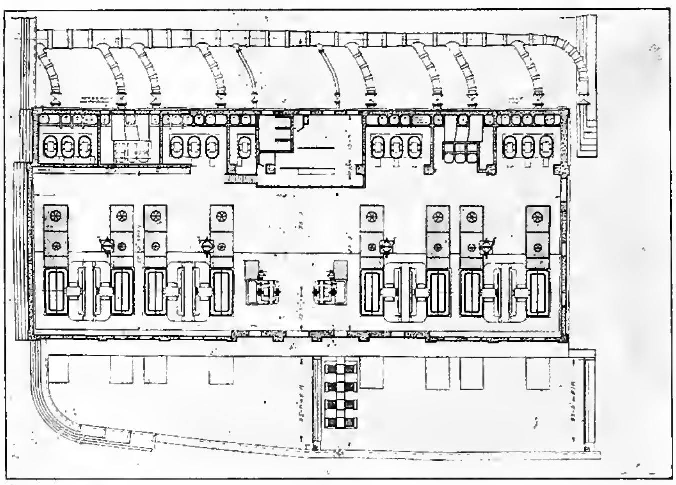
The generator leads pass through ducts to the generator switches, thence to the low tension side of the transformer banks. Although the station is not equipped with a complete 2,300-volt bus bar, tie switches are placed between adjacent machines, and equipped with double-throw switches in such a manner that any generator can be transferred if necessary to any single transformer bank, or run in multiple with some other generator on a single transformer bank, or

the entire station can be tied together by means of this transfer bus and operated as a single unit.

On the high tension side the transformer banks connect through knife-blade switches with a single bus bar, sectioned in the middle. The two outgoing circuits are tapped of this bus bar between adjacent transformer banks through remote control, non-automatic oil switches. By using these and the oil section switch, all high-tension power switching can be handled without the use of air break switches, and the investment for high grade switching is reduced to a minimum. The 2,300-volt oil switches are installed in concrete cells, having concrete barrier walls and tops. Where possible, the disconnecting switches are separated by barrier walls. In addition to installing the 60,000-volt oil switches in concrete cells, in accordance with standard practice, each has been enclosed in a separate concrete room containing no additional apparatus except lightning arresters. The high tension wiring is run in ducts, no open wiring being permitted except connections from transformers to the wall through their disconnecting switches, and from the disconnecting switches of the lightning arresters to the lightning arrester banks.

The arresters, of the General Electric Company's multiplex type, consist of alternate carbon spark gaps and resistance, in accordance with the most modern practice. The circuits are equipped with choke coils, consisting of twenty coils of hard drawn copper placed between the arresters and the oil switches.

The transmission line follows as near a straight line as



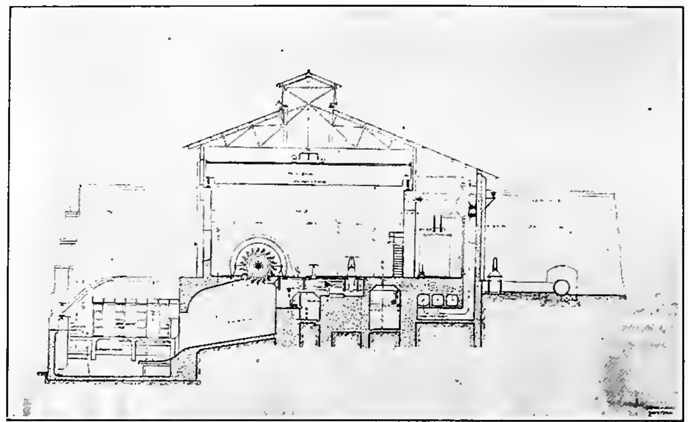
PLAN OF POWER HOUSE

possible from the power house to the mouth of the canyon. Swinging to the left there, it crosses the Cottonwood Hills, and there takes a course due south across the edge of the Bakersfield plains. Entering the mountainous section through Tejon Canyon and following across the end of Castaic Lake it crosses the divide immediately above Germain Station, where it is at its steepest portion, dropping from the hill to the road below 1,000 feet in 3,500 feet.

Great difficulty was encountered, establishing the next section, which follows the Piru Creek and tributaries. No permanent wagon road could be established, in the last five miles, making heavy angles both vertical and horizontal necessary. One U bend of the river was crossed by means of a long span, 2,250 feet, between the main supports, guided by an entirely unloaded tower at the bottom of the sag.

Leaving the Piru Canyon the line passes in almost a straight line across fifteen miles of rocky land, and after leaving the last crest, it enters the more open district surrounding Newhall, through which a permanent wagon road, to haul supplies, and to permit patrolling, was constructed, the maximum grade of which on one side was 10 per cent, and on the other ot one place 20 per cent, the ruling grade in both directions being 5 per cent.

In the Newhall district the line crosses the San Fer-



POWER HOUSE SECTION

nando Mountains directly west of the long tunnel on the Southern Pacific, running from there through open country in sight of the railroad most of the way to Los Angeles.

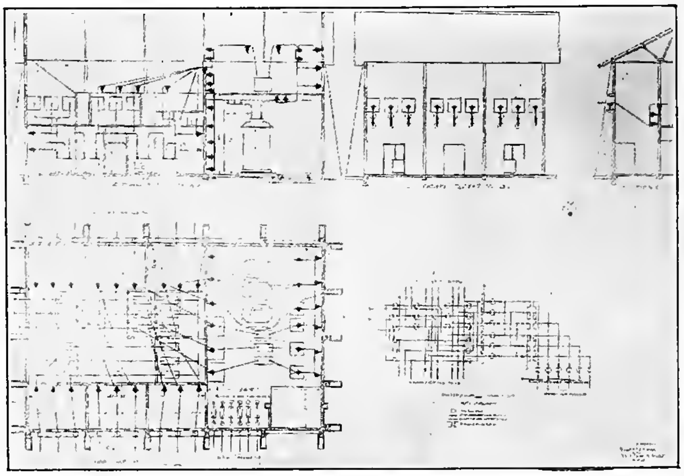
The towers, ranging in height from thirty to sixty feet, are uniformly constructed of galvanized angle iron, bolted with galvanized bolts and held in shape by means of tension rods. With the exception of one pair in the upper portions of the sides and between the cross-arms, there are no compression braces. The nine insulators are spaced on six-foot centers, five on the upper arm and four on the lower.

The towers, all portions of which are figured to be safe under a wind pressure of thirty pounds per square foot on the tower and the wire of a 700-foot span, will withstand the absolute failure of any single wire, none of the resultant strain being transmitted to adjacent wires nothwithstanding.

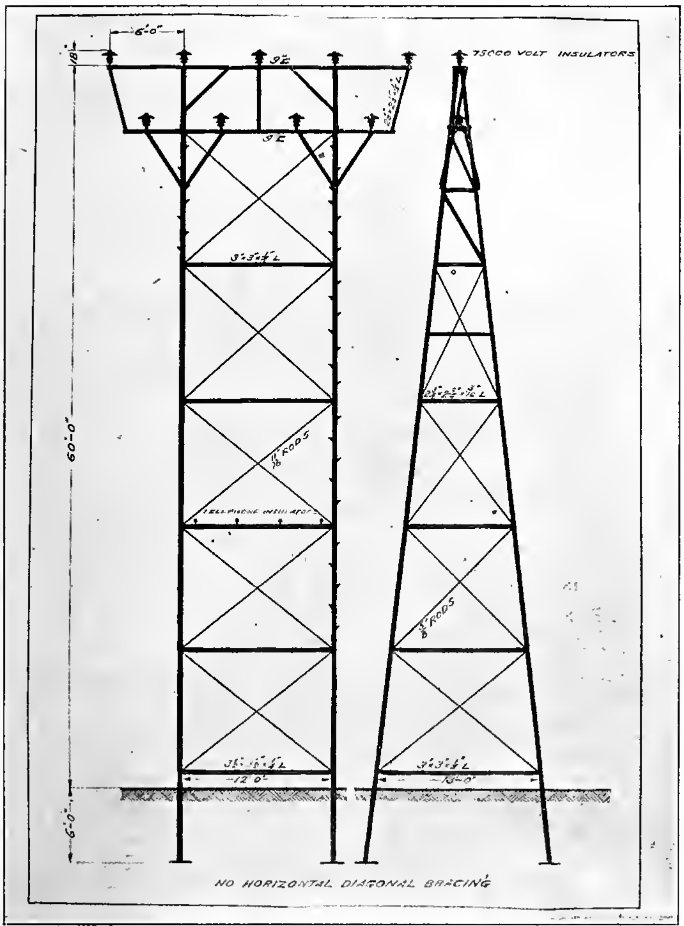
No cast-iron was used except in the foot plates, which are twenty-four inches in diameter, painted black. They are attached to the bottom of 4x4-foot galvanized posts, painted black, bolted as extensions to the corner posts of the tower and set in the ground a depth of six feet in tapered holes. No concrete footings were used, except in some places in the city of Los Angeles, where the tower heights in many instances exceed sixty feet. The tower parts were made as light as possible with a factor of safety of each steel member of not less than 2½. All connections are made with malleable iron castings with a factor of safety of 4. The insulator pins are cast steel and furnished as a part of the tower, bolted to the tower with four bolts and cemented into the insulators.

The transmission line is designed to consist of three circuits with the wiring spaced symmetrically on six-foot centers. The wire, sampled and tested at the mill before accepted, is 7-strand 4/0 hard drawn copper, having elastic limit exceeding 35,000 and an ultimate strength of 62,400 lbs.

The wire was greased and shipped in reels of two lengths



SUBSTATION AND SWITCH-HOUSE



STEEL TRANSMISSION TOWERS

of 4000 feet each. As only six conductors are being strung at present it was desirable to leave the easiest circuits to be pulled in later. Three wires were threaded through the cable at a time, by carrying them across rollers bolted to the arm.

The accompanying illustration shows the type of clamp used. The tie wires are of No. 1 copper strand, the four bolt clamps are of brass, and the U piece placed on the top of the insulator to prevent chafing is made of No. 24 copper.

The tie wires fail in test at about 4000 pounds, while the insulators are guaranteed to stand 4000 pounds and fail at approximately 9000 pounds, thus making the normal failing point uniform.

The transmission line was careied on as long spans as the character of the country would permit, with towers not exceeding sixty feet in height. The clearance on telephone wires was made at a minimum of seven feet while the ground clearance was determined by the survey party as it went along.

The transmission lines are carried through from one end to the other with transpositions only at switching stations, of which at present there are but three, two of which contain transformer sub-stations.

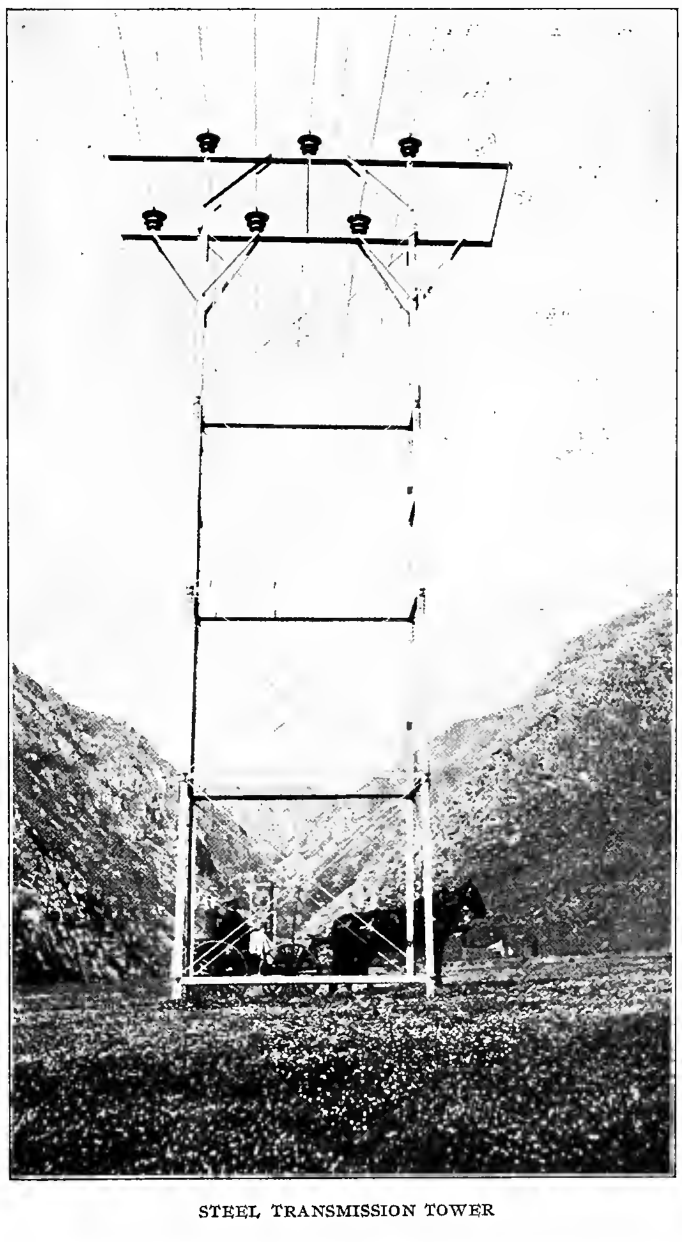
The switching station proper is equipped with two sets of oil break switches, connected one set after another into a complete circle for each line, and two sets of knife-blade disconnecting switches for each line. After passing through the disconnecting switches the incoming lines are tapped between alternate oil switches. The corresponding outgoing circuits, from the vacant pumpers left after the lines have been tapped in, leave the building on the opposite side.

These buildings are made from concrete. The circuits are isolated from each other by means of concrete barriers and floors. Individual leads of the same circuit are run in the same compartment. Horn lightning arresters can be connected to the circuits at these sub-stations at any time if necessary.

The switching station at which are located the two transformer sub-stations are arranged the same as the others, except that openings were made in the west wall, through which to take leads into the adjacent transformer house. Provision has been made in the transformer house for two banks of 2100 kilowatt transformers from the transmission line at 60,000 volts and delivering to the distribution at 30,000. The high tension leads are tapped from two of the outgoing 60,000-volt circuits in the switching house, pass through oil switches and join in a common bus, from which the transformers can be separated by means of knife-blade switches.

The switchboard for all switching except the transformer switching is on a concrete deck, on the under side of which are hung the insulators for the 30,000-volt circuits, while the 30,000-volt oil switches are placed on top of the floor. The lightning arresters for the 60,000-volt circuits are on the wall between the transformer and the switch house, separated from each other by 6-foot barriers, while at the end of the sub-station below the oil switches and the outgoing 30,000-volt circuits are placed the 30,000-volt lightning arresters.

One bank of 2100 kilowatt, oil-filled, water-cooled transformers will be installed at present at Castaic to supply a 30,000-volt transmission now being built by the Ventura County Power Company west from Castaic to Saticoy where a branch is taken to Oxnard and will be eventually continued

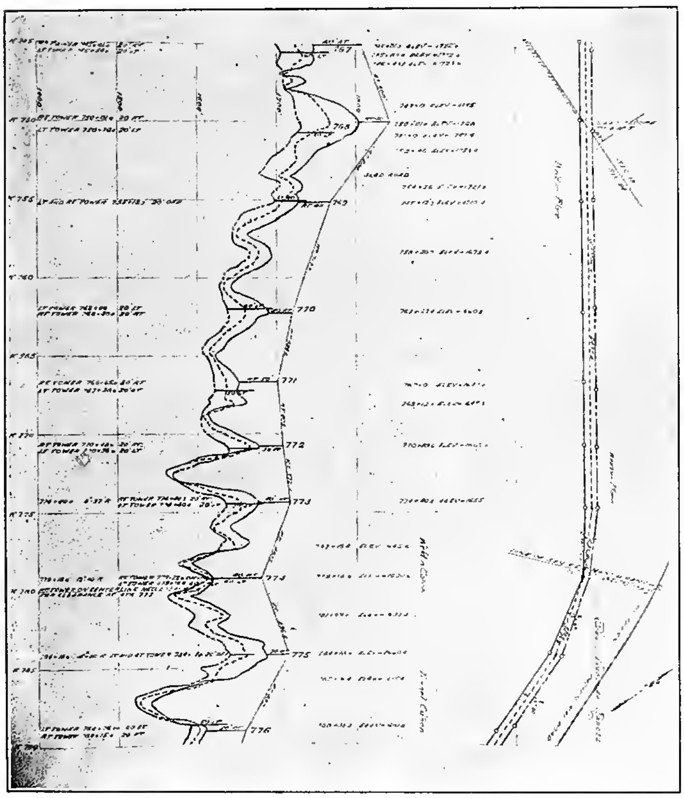


STEEL TRANSMISSION TOWER

to Santa Barbara, where the Edison Electric Company has extensive holdings.

Another 1200-kilowatt bank of the same type transformers will be installed at present at Fernando to supply local light and power at 2300 volts.

The terminal of the transmission line in Los Angeles is at the steam and transformer station known as Los Angeles No. 3. The two circuits enter the station through the east gable, pass through choke coils and enter oil switches which connect them to their respective bus bars. There is an oil switch between the two busses. Each transformer has an oil switch which can be connected by means of a double-throw, knife-blade switch to the bus bar belonging to the west or the middle circuit. The east circuit will be brought in so it can be switched on either of the bus bars. There are four step-down transformer banks, 4500 kilowatt, with their secondaries wound for either 16,000 or 32,000 volts. Under ordinary conditions the energy received from the



TRANSMISSION LINE

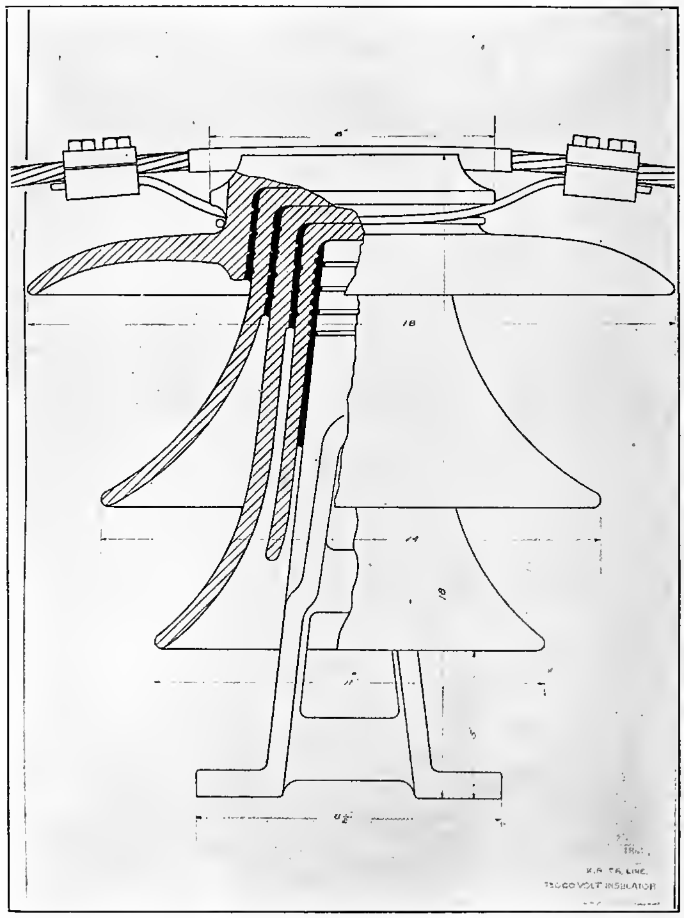
Kern River will be handled through the double 15,000-volt bus. The transformers are oil circulated, the oil being cooled in the same manner as that at the Kern River Plant No. 1, with the exception that the cooling water is circulated continuously from the oil-cooler basin into elevated troughs, from which it drops through a series of screens.

This building also contains provision for switching the old 30,000-volt transmission line with its various branches and all the 15,000-volt distribution around Los Angeles.

All bus bar wiring connections to the transformers and the outgoing circuits are carried in ducts. In the new portion of the station these are pulled with 15,000-volt leaded paper cables of 211,000 centimeter cross section, with the exception of the Westinghouse generator, which has 400,000 centimeter cables.

In 1903 two 2000-kilowatt, 2300-volt Curtis turbine alternators, with 4000 horsepower of Sterling boilers were established in units of 500 horsepower each, but in 1905 larger sized apparatus was determined upon throughout, and 5250 horsepower of 750 horsepower units was established in the boiler room. The new boilers have heavy drums fitted with superheaters in the middle drum instead of Niclasse superheaters as used in the old boilers, and are fitted to carry 175 pounds pressure, although the plant is now operated with 165 pounds at the boiler. The boilers are constructed to produce 150 degrees at the throttle against 125 degrees of the old plant. Cold water entering in the back drums passes down through the back tubes, up through the front ones, across into one end of the superheater drum, through the superheater tubes to the other end and out through the superheated steam line.

The turbine installation in the new plant consists of a single 6000-kilowatt Westinghouse-Parsons turbo alternator, with Worthington condensing equipment. The steam end is of their standard construction, receiving steam through an intermittent valve, which steam, before reaching the machine, passes through a separator, an automatic butterfly valve and a hand-operated throttle valve. This unit is four-stage, single flow, and is operated from 27½-inch to 28-inch vacuum. The by-pass throttle does not open until 9000-kilowatt load is reached under normal steam and vacuum



75,000 VOLT INSULATOR

conditions, and so far loads up to 9000 kilowatts have been carried on the machine without any indications of the maximum load being approached.

This generator is wound for 16,500 volts Y and is run with grounded neutral on the 50-cycle distribution of the company. It runs in multiple with the main system perfectly. Between the neutral of the machine and the station ground wire, a potential difference of several hundred volts exists under operating conditions, which place the machine in connection with Y to delta connected transformer banks. This voltage and the resultant flow where the neutral switches close varies with the number of transformers and the load on them, but does not appear to vary from other causes.

The plant is equipped with steam condensers, heaters, vacuum pumps, coolers, etc.

This unit was put in service in October, 1906, and has been run ever since without any shut-down due to the turbine and without any shut-down of any seriousness.

ORGANIZATION AND CONDUCT OF A NEW BUSINESS DEPARTMENT SUITABLE FOR CENTRAL STATIONS IN CITIES OF 50,000 POPULATION AND UNDER.

By W. W. Edwards.

It is the purpose of this paper to call your attention briefly to a few features of central station lighting which seem to be somewhat neglected, especially in the smaller cities, and to suggest methods for their improvement. While in some instances, efforts are being made to improve electric lighting service along these lines, no systematic course is being followed. Reference is here made to a field of operation which has for its object the general improvement of all kinds of illumination furnished by electric energy, and which as applied to interior lighting lies beyond the customer's meter.

A good deal of attention has always been given to the tracing and stopping of central station losses, but these investigations have seldom been pursued beyond the consumer's meter, thus stopping at the very point where they should have been continued. It is becoming more apparent every day that some of the most important losses in central station lighting service are to be found in the consumer's installation, in the selection and arrangement of lamps, and the form and nature of globes and reflectors employed. The consumer at this critical stage is commonly left to his own devices. It is needless to say that the average customer understands little of the principles governing interior illumination, either for residence or commercial purposes; hence, the result can easily be imagined.

An attractive display of that which is for sale is becoming an important part of almost every business. The merchant employs those skilled in the art of arranging goods and goes to considerable expense in order that his window may present the best possible effect and thus successfully meet competition.

The electric company is in the lighting business to sell light. The competition is nearly as close as it is in the case of the dealer, but so far as the efficient use of lamps is concerned, very little is done to overcome competition from gas companies, who have already made considerable progress in the improvement of their illumination. Why should the choice and efficient use of electric lamps be left to chance any more than the selection and operation of an electric motor? In the latter case, the customer often has the expert advice and assistance of a power engineer, thus insuring the best results from the use of electric power.

One cause of dissatisfaction and decreased earnings is found in the fact that the ordinary incandescent lamp is allowed to remain on the circuit long after it has become dim and blackened, and very often until burned out. This is not only a fruitful source of complaint, but the decrease in the conductivity of the lamp constitutes in the aggregate no small loss to the lighting company.

In a general way, these are some of the evils which call for immediate attention if electricity is to maintain its present rank as an illuminant. There is no branch of central station service where the need of expert advice and supervision is greater than in the field of lighting, nor is there another where the returns are greater or more certain. We are here dealing with the net product in light, the only deduction from the consequent increase in earnings being the necessary supervision to produce this increase.

As these reforms are very closely related, they can readily be accomplished by the organization of a new business department.

Organization.

First of all, select for the head of this department, if possible, an electrician who has given some attention to the study of illumination, both exterior and interior, a man who is enthusiastic in his work and determined to make the new department a winner.

Some of the complex situations encountered in this division of the lighting service will require considerable study and comparison in order to obtain the best results; hence the necessity not only for persistent investigation but also for a keen observation of the different effects in lighting. In a city of 40,000 to 50,000 population two assistants will be required.

As to equipment, a good photometer is prime necessity. This should be mounted on a suitable carriage and equipped with a full supply of screens, also an attachment for studying reflected light. The latter will be found very valuable, as reflected rays constitute an important part of lighting, the irregular or diffused light being highly desirable for residence illumination. A simple device for studying reflected light is in the form of a large box lined with black cloth and entirely enclosed except an opening for observation of the interior and a much narrower one for the admission of artificial light. Through this narrow opening a direct ray of light is thrown upon a small reflector, the light being reflected upon any desired surface placed on the opposite side of the interior. By placing samples of wall paper instead of the reflector, the comparative reflecting properties of different shades and qualities of paper may be ascertained. However, this is only a suggestion, but a dark room of some kind is very necessary in this work.

In addition to the photometer, an indicating wattmeter will be necessary, or at least very desirable, in measuring the load of the different installations. A reliable voltmeter will also be convenient. Each workman in this department shall possess a set of hand tools such as are used for interior wiring. The department should be supplied with samples of all globes and reflectors in common use, to be employed in making experimental tests.

Besides the above-named equipment, the department itself will invent many devices to aid in the successful conduct of its work. Most of these, as well as the photometer, will be used mainly in testing and making comparisons—a kind of laboratory practice, the results of which will be used in actual practice, where the different lighting effects are noted almost entirely by the eye.

This department will have charge of all illumination furnished by the central station. Useful illumination includes or may be considered under these three heads: Residence, commercial and street lighting. Of these, residence and commercial lighting will receive first attention in this paper.

The incandescent lamp still occupies an important place in this class of illumination, hence it may be mentioned that there are at least two prime essentials for good service from these lamps.

First—There must be central station control of the lamp supply and renewals in order that the proper efficiency, size, and type of lamps may be intelligently selected and used, and that dim and blackened and burned-out lamps may be properly removed from the circuits.

Second—There should be a periodical overhauling of lamps in circuit, inserting new lamps in place of those which have passed the period of their useful life.

The order of work in the new department will be about as follows: First, installation; second, improvements; third, renewal of incandescent lamps. Both in the installation and in the improvement of lighting service, the new department will work entirely in harmony with existing departments. To this end all work orders will be issued from the main office.

First in order is the work of installation as applied to residence and commercial illumination. When an application is made for electric lighting, the interior wiring of the building usually having been done by contractors, an installation order is made in several copies at the office by means of

carbons, a copy being sent to each department having work to do on the installation.

Form 1.

Order No........ ....Electric Company.

Lighting Installation Order.

Date......................m, 190....

Name ....

Address ....

Run Service.................... Install Incandescents.........

Connect Service .... Install Arcs ....

Inspect Premises (Ill. Eng.

Dept.) .... Install Nernst..............

....

Signed.....................................

Report ....

....

Date..........................m, 190....

Signed...............................

(This refers only to delivering and placing in position.)

The service department at once runs service lines to the building, or merely connects them as the case may be, while at the same time a man from the illuminating engineering department makes an inspection of the premises and assists the customer in the selection of lamps, reflectors, etc., best adapted to the particular purpose for which each is to be used. In the efficient use of lamps an ounce of prevention is worth a pound of cure. Meanwhile a meter is installed by the meter department, an installation receipt being taken for that part of the entire installation belonging to the company. Every detail necessary for the satisfactory lighting of the premises is considered before leaving, the quality as well as the quantity of the light receiving attention. The customer is thus given to understand from the beginning that the company understands its business and is determined to insure for him the very best results possible. Too much stress can not be placed upon the importance of establishing and maintaining this favorable impression on the part of the customer.

Regarding the installation of street arcs, the supervision of this branch of illumination will require little attention from the new department, except in special cases where local conditions render changes necessary in the position of individual lamps or in the character of globes and reflectors used thereon.

Improvement in existing lighting service is the next step. Naturally any complaints regarding unsatisfactory lighting service will receive first attention. Uniformity and promptness of action are secured by means of an operation order, which, like the installation order, is issued from the office and is made in more than one copy if the attention of other departments is desired.

Form 2.

Order No......... ....Electric Company

Operating Order.

Name ....

Address ....

Repair Service............... Remove Meter............

Disconnect Service .... Remove Inc. Lamps ....

Test Meter .... Remove Arc Lamps ....

Improve Illumination ....

Signed.................................

Report ....

Date ....m, 190....

Signed.................................

Whatever difficulty, it is located and remedied, even though it involves radical methods and some expenditure. Complaints have always existed in a greater or less degree, but it is hoped and confidently expected that with the advent of the illuminating engineering department this class of complaints will entirely disappear.

In this connection it may be well to mention two existing difficulties which will cause the new department no little annoyance. One is the tendency on the part of those doing the interior wiring to allow for only a limited number of outlets or to distribute them improperly, regardless of the fact that as much depends upon the efficient use of a lamp as upon the efficiency of the lamp itself. The other difficulty lies in the color and quality of wall and ceiling paper and the shade of interior finish. Many customers will select somber green or other dark colors, apparently ignorant of the fact that this shade of paper is a powerful absorbent of light and will not reflect more than twelve to twenty per cent of the light thrown upon it. While this results in an increased use of current, the gain is more than offset by the annoying complaints of the customer and the misleading reports which he will circulate in regard to the cost of electric lighting.

The opportunities for improvement in lighting efficiency are many, but in most cases the obstructing ideas or existing carelessness must be located by persistent search. The adjustment of a few complaints is only a beginning. The real aim of this department can be accomplished only by a systematic examination of the premises of every customer on the circuits. In some instances quite extensive alterations may be necessary, but a satisfied customer is a good customer to have. In order to demonstrate the advantages of making certain changes, it may often be desirable to temporarily install a different kind or size of lamps, suitable reflectors if necessary, the customer signing a temporary installation receipt therefor.

Form 3.

..........................Electric Company.

Temporary Installation Receipt.

Received of the......................Electric Company of...........................the following, same being temporarily installed for demonstration and may be renewed at any time after date upon surrender of this receipt:

	C. P. Lamps, Inc.		Arc Lamps
	C. P. Lamps, Inc.		Nernst Lamps
	C. P. Lamps, Inc.		Globes
	Watt High Efficiency		Reflectors

....

Signed ....

Address...............................

In all cases the necessary articles may be obtained from the store room by means of a requisition.

Form 4.

Requisition No....... ....Electric Company.

Date.......................190....

Storekeeper:

The following is required for..........................

....

Approved:.......................

Signed.................................

The above received................m, 190....

Signed.................................

When articles are returned to the store room, the department will receive a store receipt for same.

Form 5.

Number.......... ....Electric Company.

Store Receipt.

The following has been received today by..............
from............................

....	....	....	....
....	....	....	....
....	....	....	....
....	....	....	....
....	....	....	....

Signed..................................

Storekeeper.

The consumer is at all times given the benefit of valuable advice regarding illumination, and will soon learn to consult this department before making any change in his lighting installation.

The improvement of street lighting will usually require only limited attention after the first year unless some general change is made in the style of arc lamps or in the character of globes and reflectors employed, such as to necessitate a different elevation of the lamps in order to obtain the best service therefrom. In case a narrow street renders any change necessary in the elevation of the lamps, or the proximity of a dark alley makes a different kind of a globe or reflector desirable on an individual lamp, the new department will report same to the office with particulars. A regular operating order will then be issued to the department having charge of this work.

We have reached the last division in the work of this department—the renewal of incandescent lamps. Great diversity of opinion exists in regard to the proper stage at which it is profitable to remove the incandescent lamp from the circuit. Many central station companies in the smaller cities make no attempt whatever in this direction, except to furnish free renewals as an inducement to customers to return lamps when burned out.

In every well-conducted electric lighting business, the renewals of incandescent lamps are carefully recorded and form one branch of distributing expense; hence the manager knows the monthly expenditure for this purpose, often regarding the same as a direct loss. Though not strictly a part of the subject of this paper, a few reasons are here given for the following plan of renewing lamps.

The useful life of a 3.1 watt lamp at normal voltage is estimated by good authority to be 400 to 450 hours, the 3.5 watt lamp about 800 hours, at which time the candle power has fallen to about eighty per cent of rated value. Practical test demonstrates the fact that a lamp which has passed the above period will not conduct as much current as before, the difference increasing with every hour the lamp remains in service.

It is true that the lamp will require more current per candle power of light delivered, because the candle power decreases faster than the consumption of current, caused in part by the deposit of carbon on the inner surface of the glass bulb, causing it to become blackened. On the other hand, the total amount of current passing through this lamp in a given time will be less than in the case of a new lamp, chiefly because of loss of conductivity in the carbon-treated filament of the old lamp.

It is safe to say that thousands of dollars are wasted by lack of attention to this important principle, enough to repay many times the extra cost of renewals.

The habit of allowing lamps to remain on the circuit after passing the period of their useful life is therefore not only an injustice to the customer by reason of decreased candle power, but a direct reduction in the earnings of the lighting company. For these two reasons it is imperative that a systematic renewal of lamps be made at stated intervals, these being more frequent during the winter months. Any desired conveyance may be used for this purpose, from a one-horse wagon to an automobile, record book containing a record of the number and candle power of lamps both delivered and returned is signed by the customer.

Form 6.

......................Electric Company.

Incandescent Lamp Renewals.

Date	C.P. Lamps Delivered	C. P. Lamps Ret'd	Customer's Sig.	Address
......	....	....	....	....
......	....	....	....	....
......	....	....	....	....
......	....	....	....	....
......	....	....	....	....

(To be in book form with heavy covers. Totals at foot of page).

In this way the accounting department may not only compute the number of renewals, but also note any slight changes of candle power in the customer's installation. Lamps are obtained from the store room upon requisition, the same as other supplies.

Thus the brilliancy of the incandescent lighting service is maintained unimpaired, resulting in the satisfaction of the customer and in a substantial increase in the earnings of the lighting company.

Necessary Accounting.

The addition of the new department need not materially increase the work of accounting. The equipment and tools employed will constitute a branch of equipment and tool accounts respectively, these being classed as assets.

Salaries and wages, as well as any other operating expenses of the department, will be entered on a running work order sheet which will be charged monthly to a division of distributing expense known as Illuminating Engineering, only one entry a month being necessary. The temporary installation receipts on hand will at all times show the limited amount of outstanding lamps and other supplies.

The work of soliciting for the sale of light, heat, and heating or other electric devices may profitably be associated or even combined with this department if deemed advisable, as the engineering of illumination develops ability for, and leads very naturally to the soliciting of patronage along this and kindred lines.

The writer has endeavored to point out the urgent necessity of certain reforms in central station lighting as applied to the smaller cities, and to outlining a simple method for the accomplishment of these reforms. No attempt has been made at elaborate forms or intricate methods, the object being to make the conduct of the proposed new department as simple as possible, consistent with results.

Whatever may be the means employed, the engineering of illumination demands and must have prompt attention if electric energy is to hold its own in the field of modern lighting.

Coeur d'Alene, Idaho.—F. E. Leonard, superintendent of construction for the Rocky Mountain Bell Telephone Company, has completed plans for the erection of a building for the company to be 25x50 feet, and one-and-a-half stories, of pressed brick and fireproof construction, and to be equipped with a steam heating plant.

The JOURNAL OF ELECTRICITY POWER AND GAS

WITH WHICH IS INCORPORATED The Engineers, Architects and Builders' News

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EASTERN AGENCIES

NEW YORK ....

CHICAGO ....

ST. LOUIS ....

WESTERN AGENCIES

LOS ANGELES ....

PORTLAND ....

SEATTLE ....

Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," with which is incorporated "The Engineers', Architects' and Builders' News."
Entered as second-class matter at the San Francisco Post Office, August 15, 1899.
Entered as "The Electrical Journal," July, 1895.
Entry changed to "The Journal of Electricity," September, 1895.

VOL. XVIII JUNE 8, 1907 No. 23

EDITORIAL.

CONCILIATION OF LABOR AND CAPITAL.

By the establishment and success of Trade Unionism it cannot be doubted that the world has been bettered. Before laboring men formed organizations and felt their strength the condition of the average toiler was far from satisfactory. To organized labor, indeed, we owe many improvements, not only in the conditions that surround, and now dignify, labor, but for the fact that under such improved conditions better work is accomplished, and, therefore, society has been benefited. In the old days the individual workman was at the mercy of his employer. He could only feebly protest against insufficient and entirely disproportionate reward for the product of his labor, while frequently he was forced to work under most unsanitary surroundings. In brief, his hours were long, his pay was poor, and his condition deplorable. It needs no argument to prove that the fundamental principles of Trade Unionism are sound and incontrovertible; nor will it be denied by any fair-minded person that society has been benefited by its establishment. Before the voice of organized labor was heard in the land and its concentrated forces realized, there were no laws to prevent the employment of children in factories; and for the practical abolition of child labor—except in some States in the South—the world is especially indebted to Trade Unionism.

Naturally enough, however, Trade Unionism has generated abuses as well as uses. With the tendency of the age to concentrate energy and to eliminate futile and ruthless competition, organized labor has become an even more powerful and dictatorial combination, or Trust, than almost any combination of capital. It is true that Labor has not exercised the same influence and power in politics as has Capital, but it is only because organized labor has only intruded itself into politics within the last few years. In Australasia, Labor Unionism has asserted itself and proved predominant, with as yet uncertain results. In San Francisco Labor Unionism was able to establish a political as well as an industrial stronghold, and now that a day of reckoning has been precipitated we must admit with regret that it has been tried and found wanting.

Among the most transparent abuses of Labor Unionism must be recognized the faulty and unconstitutional principle that the Unions shall establish a monopoly of labor. In effect they say: No man shall work in a community dominated by Labor Unions unless he subscribes to the Unions. That is to say, the freedom and will of the individual as guaranteed by the Constitution of the United States is directly violated. The individual citizen must be at liberty to work for whom, when, where and how he pleases. The individual employer must be at liberty to engage whom he please. The employer has the right under the law and Constitution to employ Labor Unionists or non-Unionists as seems best to his judgment. Hence all attempts to restrain the freedom of the individual employer or employe are illegal and unjustifiable. Hence the boycott and the picket, which are both obviously aimed to restrain trade and frustrate industry, are against the spirit if not the letter of the institutions of his country,

While the "Journal" is in profound sympathy with the fundamental principles of Labor Unionism, nevertheless it is distinctly antagonistic to the establishment of the domination of any class, and will continue to oppose with all vigor any attempt to restrain trade or to frustrate industrial freedom. Furthermore, it is impossible to acquit the Unions of San Francisco of a large share of responsibility for the social disorder which has disgraced our streets, precipitated riot, and continues to menace life and property. If the Labor Unions of San Francisco had been honestly determined to keep the peace and thereby earn the respect and confidence of the community, they should have turned their members into citizen police instead of lawless pickets and boycotters. We say to the Labor Unionist, as we say to the Capitalist—this is a free country; employer and employe alike are guaranteed liberty of action and protection in that action under the law. We maintain that the peace and prosperity of this community can never be established as long as we submit to the dictation of any class. The people, and neither Capital nor Labor, must rule, unless this Republic is to be overdrawn.

Hence "The Journal" protests once more against the alignment of Capital against Labor, against class division and hatred. The arrogance of the capitalist and the agitation of demagogue, jawsmith and walking del-

egate are responsible for the all too obvious and ugly class feeling which to-day exists in San Francisco, and which sometimes threatens to render the true and natural interdependence of Labor and Capital hopeless.

Therefore, our deepest sympathy and most earnest support is given to any measure or motion toward conciliating these opposing forces. We believe, to quote the late Senator Hanna once more, that "both Capital and Labor must yield in time to the great law of fair dealing between man and man."

Unhappily, however, in some of the industrial troubles that now vex and obstruct San Francisco it would appear that direct conciliation is no longer possible. Nor can we blame the president of the United Railroads for his firm determination never again to recognize the Carmen's Union. Reviewing the history of the negotiations between the United Railroads and the Carmen's Union for the last year, the fair-minded man must admit that Mr. Patrick Calhoun has good cause for the stand he has taken and for his sturdy determination to establish the principles of the "Open Shop" in the United Railroads.

It is obvious that the street car strike, having signally failed, the Carmen's Union and their sympathizers have been driven to the last resort of seeking conciliation, although its leaders at the outset refused arbitration. It is transparent also that Mr. Calhoun's refusal again to recognize the Carmen's Union, or to treat with their leaders in any way whatever, will be used by the demagogic press and by his enemies as a ready instrument with which to assail him and to put him in a wrong position before the people. The shameful report has reached "The Journal" that agents of the prosecution and labor leaders have asserted that unless Mr. Calhoun will consent to conciliation with the Carmen's Union he relinquishes the last chance to escape the penitentiary. There can be no compromise with lawlessness.

THE WRONG METHOD.

To the stranger San Francisco certainly has a busy look. Her many troubles are not so apparent as the daily press would make one believe. It is doubtful if one would know that a great street car strike existed unless information to that effect was volunteered by some one. General appearances mean a great deal, and the many large and thoroughly modern new buildings now being completed make sure the future of the city. A very large amount of effective work is going on, and the results are beginning to show. There is more co-operation and mutual helpfulness between all classes than might be supposed, but not every one by a long way is doing his whole duty. The labor unions, many of them, deserve the most severe condemnation. Their attitude and motives are all wrong, the city's future being given no consideration as compared with the self interests of a single class.

But serious as the labor question is, there is no one in San Francisco who should be so harshly treated by every one as the individual, rich or poor, high or low, who at this time is withdrawing his ready cash from the channels of business and is hoarding his money as a miser. The man who takes his money from a savings or commercial bank and promptly locks it up in a safe deposit box, is an enemy to every one. He does what no man has a right to do—he withdraws from the world of finance his personal wealth. His gold can do him no good whatever when locked up and hidden. Money thus held out of the banks prevents reconstruction, and such a man is doing nothing, yes, even prevents others from doing anything, toward the future of San Francisco. We can think of no person who is so contemptible as he, who as a miser in such times as these, buries his money away where it can do him no good, but in addition prevents others, who are broader and more able men, from accomplishing great good with the use of his money. It is far better for him and for all if he leaves his money in the banks where it is safe and yet will in one way or another be used for the city's good.

PERSONAL.

W. M. Carpenter, representing Walworth & Neville Mfg. Co., of Chicago, is in San Francisco.

Jean Bart Balcomb has been elected general manager of the Hudson River Concrete Company, 26 Court Street, Brooklyn, N. Y.

G. U. G. Holman has been appointed manager of the electrical department of the Boston branch of the H. W. Johns-Manville Company.

Thos. I. Stacey, secretary and treasurer of the Electric Appliance Co., of Chicago, has been visiting the San Francisco branch during the past week.

Mr. Henry F. Frosch, for fourteen years with the Chicago Edison Co., at Chicago, is now manager of the Edward H. Niesz Co., at Los Angeles.

A. Reuterdahl has been elected president of the Society of Technical Industry, organized recently at Spokane, Wash. Other officers are: A. E. Brown, first vice-president; F. Crandall, second vice-president; C. Wood, third vice-president; J. J. Sullivan, treasurer; R. B. Lee, secretary; A. Wadham, F. P. Mesick and H. Powell, managers. At the last meeting an abstract from the report of the Geological Survey, entitled "Experiments on Steel-Concrete Pipes on a Working Scale," was presented by O. O. Wolcott. Mr. Reuterdahl will present a paper on "The Theory and Design of a Reinforced Concrete Arch," at the July meeting.

TRADE CATALOGUES.

Lidgerwood Electric Hoisting Engines are shown in a pamphlet from the Lidgerwood Manufacturing Company, 96 Liberty Street, New York City.

Chase-Shawmut Company send circulars and miniature bulletins covering some of their special lines, of which the following is a list: Shawmut Ground Connection Clamps, Extended Terminal Fuses, Pocket Test Lamps, Boston Cable Clips, Red E Solder Paste, Porcelain Cut-out Blocks.

LOCAL STOCKS AND BONDS

Furnished by Courtesy San Francisco Stock and Bond Exchange.

Outstanding	INTEREST	MISCELLANEOUS BONDS.	MAY 31		JUNE 3		JUNE 4		JUNE 5		JUNE 6			
			Bid	Asked	Bid	Asked	Bid	Asked	Bid	Asked	Bid	Asked	Bid	Asked
1,532,000	F & A	Associated Oil Co. 5%		82		82		82		82		82		
2,250,000	M & S	Bay Counties Power Co. 5%		99		99		100		100		100		
1,000,000	F & A	Cal. Central Gas & El. 5%		104		104		104		104		104		
9,600,000	M & S	Cal. Gas & El. Gen. M. & C. T. 5%	75	80		80	75	77½	75	77½	75	77½		
900,000	J & J	California St. Cable Co. 5%	100		100		100	100	100		100			
2,000,000	J & J	Contra Costa Water Co. 5%		102½		102½	101½	103	100	102	100	102		
1,000,000	J & J	do do Gen. Mtg. 5%		97		97		97		97		97		
623,000	F M A N	Edison Light & Power 6%	111	119	111	119	111	119	111	119	111	119		
650,000	M & S	Ferries & Cliff Ho. Ry. 6%	104		102½		102½	105½	102½	105½	103¾			
671,000	A & O	Geary St. Ry. 5%	52		52		52		52		52			
610,000	M & N	Honolulu R. T. & L. Co. 6%	104¾		105	106½	105	106¼	105	106¼	105	106¼		
300,000	A & O	Lake Tahoe Ry. & T. Co. 5%												
500,000	J & J	Los Angeles Elec. Co. 5%	100		100		100		100		100			
1,300,000	J & J	Los Angeles Gas & Elec. Co. 5%	99½		99½		99½		99½		99½			
5,000,000	A & O	Los Angeles Ry. 5%	105¾	107	105¾	107	105¾		105¾		106			
1,000,000	A & O	Los Angeles Lighting Gd. 5%		105		105		105		105		105		
1,500,000	A & O	Los Angeles Pac. R. R., 1st Con. Mtg. 5%		104		104		104	100½	103½	102			
3,030,000	M & S	L. A. Pac. R. R. of Cal. 5%	99¾	102	99¾	102	99¾	102		101½		101½		
3,000,000	J & J	Market Street Cable 6%	105		105		105		105			108		
5,141,000	M & S	do Ry., 1st Cons. Mtg. 5%		106		106		106		104½		105		
100,000	A & O	Mill Valley & Mt. Tamalpais S.Ry. 5%	103		103		103		103		103			
4,751,000	A & O	Northern Ry. Co. of (Cal.) 5%	109	110½	109	110½	109	110¼	109	110¼				
1,498,000	J & J	North Pacific Coast R. R. 5%		101½		100¼	100	101	100		100			
1,074,000	J & D	Northern Cal. Railway 5%												
980,000	J & D	Northern Cal. Power Co. 5%		101		101		100		100		100		
6,000,000	A & O	Northern Electric Co. 5%		97½		97½		97½		97½		97½		
1,000,000	M & S	Oakland Gas Light and H. 5%	102	106⅞	102	160⅞	100	106	100	106	100	106		
1,374,000	J & J	Oakland Transit Co. 6%		114		114	109	111	108½	111½		112		
1,600,000	J & J	Oakland Transit 5%	101½		101½		101½		101½		101⅝			
1,326,000	J & J	Oakland Transit Con. 5%	100	101	100	101½	100	101¼	100		100	101½		
7,000,000	J & J	Oakland Traction Con. 5%		100½		100		100		100		100		
1,500,000	J & J	Oakland Water Co. gtd. 5%		99		99		99		99		99		
2,000,000	A & O	Omnibus Cable Ry. 6%	112	118	112	118	112	118	112	118	112	118		
1,149,000	S D M J	Pacific Gas Imp. 4%		92½										
8,494,000	J & J	Pacific Electric Ry. Co. 5%	102⅛	102½	102⅛	102½	101¾	102½	101¾			102		
4,491,000	J & J	Pacific Light & Power Co. 5%		100½		100½		100½		100½		100½		
3,000,000	J & J	Pacific Tel. & Tel. Co. 5%		103		103		103		103		103		
350,000	J & J	Park & Cliff House Ry. 6%	100		100		100		100		100			
250,000	J & J	Park & Ocean R. R. 6%		112½		112½		112½		112½		112½		
700,000	M & S	Powell Street Railway 6%		107½		107½		107½		107½		107½		
2,500,000	M & N	Sacramento Elec. Gas & Ry. 5%		100	98		98	101	98		98			
6,000,000	A & O	S. F. & S. J. Valley Ry. 5%		108¼	108½		108½		109		109¾			
3,000,000	J & J	S. F., Oak. & San Jose Ry. 5%	100	107	100	107	100	107		106	103¾	105		
1,500,000	J & J	do do 2d Mtg. 5%		101		101		101		101		101		
1,500,000	A & O	S. J. & S. Clara Co. R. R. 4½%		91		91		91		91		91		
642,000	A & O	Sierra Ry. of Cal. 6%	107		107		107		107		107			
6,000,000	J & J	S. P. R. R. of Arizona 6% (1909)	103¼		103¼		103⅜		103¼		103½			
4,000,000	J & J	do do do (1910)	104		104		104		104		103¾	105		
5,116,000	A & O	S. P. R. R. of Cal. 6% (1912)	105½		105½		105½		105½		105½			
4,127,500	M & N	S. P. R. R. of. Cal., 1st c. gtd. 5%	114	116½	114	116½	114	116½	114	116½	114	116½		
3,533,000	A & O	S. P. Branch Ry. of Cal., 6%	121½	130	121¾	130	121½	130	121½	130	121½	130		
81,178,000	J & J	S. P. R. R. Co., 1st Ref'd'g. 4%	90		90½	91	90	91	90		90			
17,500,000	J & D	Spring Valley Water Co. Gen. Mtg. 4%			85			86		86				
300,000	M & S	Stockton Gas & Elec. Co. 6%	100		100		100		100		100			
2,000,000	J & J	United Gas & Elec. Co. 5%										70		
20,000,000	A & O	United R. R. of S. F. 4%	69⅞		69¾	70	69¾	70	69¾	70	69½	100¼		
2,500,000	M & N	Valleys Counties Power Co. 5%		100¼		100¼		100¼		100¼		85¼		
		Water Stocks.												
		Contra Costa	59		59		59		59		59			
6,000	Quarterly	Marin County		62		62		62		62		62		
280,000		Spring Valley Water Co.	19	19¼	19	19¼	18⅞		18⅞		19	19¼		
		Gas and Electric Stocks.												
37,500		Martel Power Co.												
9,340		Mutual Electric Light Co. (Ctfs.)	4½		4½		4½		4½		4½			
37,336		do (Extended Ctfs.)		13		13	12¼	13¼	12	13	12	13		
40,000	Monthly	Pacific Lighting Co.	58		55		55		55		55			
12,000		Stockton Gas & Elec. Co.	52		52		52		52		52			
		Street Railroad Stocks.												
10,000		California		142½		142½		142½		142½		142½		
10,000		Geary		41		41		41		41		41		
10,000		Presidio		25		25		25		25		25		
	Semi-an.	Associated Oil Co.	33¾	34¾	34	35	34	35	34	34¾	33½	34		
1,625	Quarterly	Mill Valley & Mt. Tamalpais S. Ry.		110		110		110		110		110		
180,000	Quarterly	Pac. Tel. & Tel. Co. (Pfd.)		100		100		100		100		100		
180,000		Pac. Tel. & Tel. Co. (Common)		15	7½	15	9	15	9	15		15		

Unlisted Securities

Outstanding	Interest	Security	May 31 Bid	May 31 Asked	June 3 Bid	June 3 Asked	June 4 Bid	June 4 Asked	June 5 Bid	June 5 Asked	June 6 Bid	June 6 Asked	Bid	Asked
750,000	A & O	Bay Counties Power Co. 6%		103		103		103		103		103		
745,000	M & S	Blue Lakes Water Co. 6%												
2,000,000	A & O	California Northwestern Ry. 5%		108		108		108		108		108		
160,000	J A J O	Marin County Water 5%		100		100		100		100		100		
600,000	J & J	Risdon Iron Works 5%		100		100		100		100		100		
500,000	M & S	S. F. Dry Dock 5%		109		109		109		109		109		
8,000,000	M & N	S. F. Gas & Electric 4½%		95		95		95		95		95		
3,926,000	J & J	S. F. & North Pacific Ry. 5%		107½		107½		107½		107½		107½		
5,500,000	J & J	South Pacific Coast Ry. 4%		95		95		95		95		95		
		Standard Electric Co. 5%		92½		92½		92½		92½		92½		
		do do Gtd. 5%		95		95		95		95		95		
750,000	J & J	Sunset Tel. & Tel. Co. 6%												
2,250,000	A & O	Sunset Tel. & Tel. Co. 5%		105¼		105¼		105¼		105¼		105¼		
1,000,000	M & N	Sutter Street Railway 5%		105		105		105		105		105		
		Stocks.												
50,000	Monthly	Gas Consumers' Association												
100,000	Monthly	Northern Cal. Power Co.	20	20½	20	20⅜	20		20		20	20¾		
		Pac. Gas & Elec. (Pfd.)		50		50		50		50	55	60		
		Santa Cruz Port. Cement	52½	65	52½	65	52½		55	60		65		
		Standard Port. Cement (New)		65		65		65		65		65		
50,000	Monthly	Truckee Electric Co.	15		15	16½	15	17	15	17	15	17		

Electrical Construction for the Architect

ELECTRICAL CONSTRUCTION FOR THE ARCHITECT AND ENGINEER.

The Elements of Artificial Lighting.

The placing of means of illumination is an important part of the design of buildings by the architect. In satisfying future tenants there are three elementary essentials of artificial lighting. First, there must be enough; second, it must be steady, and, third, it must be suitably placed. As to the amount, it is ordinarily figured that there should be from two to five candle power per foot of working surface, the important consideration being the amount reaching the eye from the object viewed, without regard to the light elsewhere. The criterion of steadiness is satisfied by a light that does not flicker. In an electric or gas lighting system this is dependent upon the distributing system. The amount of copper to conduct the required current should be carefully figured, and this being correct, any unsteadiness may be traced to the power plant, thereby shifting the responsibility from the architect.

But the problem of placing the lights is one which the designer must solve. The first consideration is that very bright light sources must not be within the field of view. All incandescent lights and all arcs without diffusing globes come within this classification. Clear bulb lamps should be used only when placed so high as to be out of the field of vision for ordinary work, or when screened by a shade or globe large enough to entirely conceal them.

In an article on this subject Dr. Louis Bell states that the eye is most tolerant of light having a general downward direction, and the old rule that the light should come from over the left shoulder is a very safe one. The downward lighting insures the light striking the work at a moderate angle of incidence, so that the light diffused from it is considerable, and the position over the left shoulder means that the light itself is out of sight and that for right-handed people at least the shadow of the hand is not upon the work. Shadows play an important part in illumination. A light so completely diffused as to abolish shadows is rather trying to work by, and the extremely dense shadows given by small and brilliant lamps are equally bad.

A large diffuse source that gives perceptible but not obtrusive shadows is the most comfortable light by which to work. The old-fashioned student lamp, with a large porcelain shade, gave probably as comfortable a light as has ever been devised, albeit rather smelly and of only moderate power. Do not be afraid of cutting off light by diffusing shades, for a loss of say a third generally makes the remaining two-thirds more effective for good seeing than was the whole. Not only should bright lamps be kept out of view, but brilliantly illuminated patches should be avoided. Every one knows how troublesome is a little spot of brilliant sunlight on one's book, and how it tries the eyes. One can get the same effect of violent contrast with artificial light and should make every attempt to avoid it.

Desk lamps are most frequently troublesome in this way. If not actually in the field of vision they throw a most needlessly and often injuriously strong light in a bright patch, contrasting violently with the surroundings. When used they should be completely concealed in deep and wide shades, and there should be plenty of general light on the desk to relieve the contrast.

Uniform distribution of light in offices and the like is important. If economy is a primary consideration a few general lamps in diffusing globes plus desk lamps where needed is the cheapest plan. If the very best illumination is desired the general lighting should be pushed high enough to enable one to read a newspaper comfortably pretty much all over the room, and additional local light rather sparingly if at all. Drafting and bookkeeping are the worst occupations for which to provide light, since they require a large amount over a considerable area.

APPROVED ELECTRICAL APPARATUS.

This department will from time to time contain an illustrated description of all fittings approved by the Underwriters' National Electric Association.

CUT-OUT BASES, CARTRIDGE FUSE.

"B. P." All capacities, 250 and 600-volt. Porcelain and slate bases. Approved May 9, 1907. Manufactured by

The Briner-Pogue Mfg. Co., St. Louis, Mo.

FLEXIBLE CORD, PENDANT.

Marking: Blue threads in cotton wind around copper strands. Approved April 2, 1907. Manufactured by

The Boston Insulated Wire and Cable Co., Boston, Mass.

LAMP GUARDS.

G. E. Portable, Cat. Nos. 25,701 and 42,681. Approved May 4, 1907. Manufactured by

General Electric Co., Schenectady, N. Y.

MISCELLANEOUS.

"Fancleve" cast iron outlet plate for knob and tube work. Approved May 9, 1907. Manufactured by

John L. Gleason, Jamaica Plains, Mass.

PANEL BOARDS.

Post Glover, 125 and 250-volt; link fuse cut-outs. Approved May 9, 1907. Manufactured by

Post Glover Electric Co., Cincinnati, Ohio.

RECEPTACLES, STANDARD.

"H & H," flush receptacle and plug, 5 A., 250-volt. A receptacle with automatic device for closing holes in fore plate for pins of plug. Approved April 27, 1907. Manufactured by

The Hart & Hegeman Mfg. Co., Hartford, Conn.

RHEOSTATS.

C. & H. field regulators and "Simplicity" theatre dimmers. Bulletins 32 and 92. Approved May 9, 1907. Manufactured by

The Cutler-Hammer Mfg. Co., Milwaukee, Wis.

RHEOSTATS.

G. E., type SA, motor starting rheostats, 110-220 and 550-volt. Approved May 9, 1907. Manufactured by

General Electric Co., Schenectady, N. Y.

SOCKETS, WEATHERPROOF.

P. & S. Composition pendant. Cat. No. 60,666. Approved May 9, 1907. Manufactured by

Dickinson Mfg. Co., Springfield, Mass., for **Pass & Seymour, Solway, N. Y.**

INDUSTRIAL

NEW CARS FOR THE CENTRAL CALIFORNIA TRACTION COMPANY.

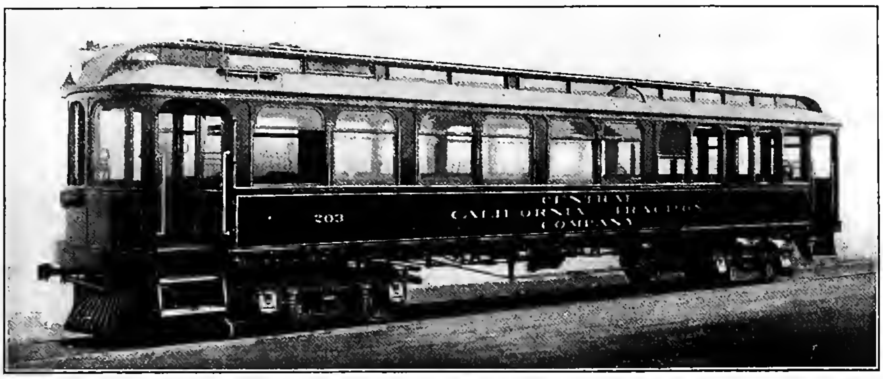
Four handsome cars of the type shown in the engraving have lately been received by the Central California Traction Company from the American Car Company, St. Louis, Mo., through their Pacific Coast selling agents, Messrs. Pierson, Roeding & Co., Monadnock Building, San Francisco. As will be seen the form of the car is unusual, both from the fact that the windows of the closed compartment are unusually large and that the open compartment at the rear is sheathed up to the belt instead of being enclosed with the wire guards usual to the double truck "California" type of car. The interior of the cars is handsomely finished in mahogany, with ceilings of mahogany veneer. The slat seats in the open compartment and plush upholstered seats in the closed compartments are of Brill manufacture. It will be noticed that the headlight is set into the forward end of the roof to give extra clearance and to facilitate repairs.

INTERIOR OF OPEN COMPARTMENT

Side sills and center sills are composed of 7-inch "I" beams; end sills are 6x7 inches, white oak; outside sill plates are 8x5/8 inches. The general dimensions are as follows: Length over end panels, 40 feet, and over bumpers, 50 feet; length of closed compartment, 25 feet, 3½ inches, and open compartment, 14 feet, 8½ inches. Width over sills, including sill plates, 8 feet, 10½ inches. Height from floor to center of dome, 8 feet, 3 inches; height from track to under side of sills, 3 feet, ½ inch; height from under side of sills over trolley boards, 9 feet, 5 inches; from track to platform steps, 17¾ inches; height of risers, 14 inches. Length of seats, 36 inches; width of aisle, 24 inches. The cars are mounted on the American Car Company M. C. B. trucks; wheel base, 6 feet, 4 inches; wheel diameter, 33 inches; axle diameter, 5 inches.

The cars are equipped with four 75-horsepower capacity motors, which operate with both 1200 volts and 500 volts, making about twenty miles an hour on the 500 volts and fifty miles an hour on the 1200. The control system is the multiple-unit control, arranged for operating on 500 and 1200 volts. There is a small dynamotor mounted on the car which furnishes 500 volts when the cars are running on the 1200-

INTERIOR OF CLOSED COMPARTMENT



CALIFORNIA TYPE OF CAR FOR STOCTOKN–SACRAMENTO LINE

volt supply, the control, air pumps, etc., being connected to the 500-volt side of the dynamotor. The dynamotor is operated only when the cars are running on the 1200-volt currents. The cars are equipped with a straight air brake system, furnished with an emergency train line and an emergency valve which will protect the train in case of a break in two or broken air hose or other failure of the straight air line. It is expected that the cars will be operated singly, and on Sundays, holidays, and special occasions in trains, so that this brake system will be most satisfactory for use on the line, as the cars will be operated as straight air cars all the time.

INDUSTRIAL.

The Bossert Electric Construction Company, Utica, New York, announce that they own the Bossert patents, No. 571,297 of November 10, 1896, and No. 682,233 of September 10, 1901, and will protect their rights under the same against all unauthorized persons or concerns making, using, purchasing or selling outlet boxes for metallic conduit construction containing the inventions of those patents. The Universal Caster & Foundry Company is licensed under said patents and is the only concern licensed under them to manufacture and sell (directly or through its agents, the Thomas & Betts Company) outlet boxes for metallic conduit construction.

The California Pole & Piling Company, with offices at Rooms 126-130, 25 California Street, San Francisco, has made arrangements to supply cedar poles and piling in any quantity from stock in their Oakland yards, located on both the Southern Pacific and Santa Fe Railroads. All sizes will be kept on hand for immediate delivery.

A NON-STOP RUN.

Electrical generators have become such a standard product that attention is seldom called to that thoroughness of design and construction which results in such a record of reliability as that shown in the following statement concerning a 150-kilowatt, 3-phase, belt-driven alternator built by the General Electric Company. This generator ran more than four years, twenty-four hours a day, with a single stop of fifteen minutes due to a defective pulley. The details of this performance are given by Mr. Rhodes, assistant manager of the United States Smelting Company, West Jordan, Utah, as follows:

"The generator was received about June 1, 1902. Put in service October 15, for eleven hours per day until November 9, when twenty-four hours per day service was required. January 25, 1904, shortly after noon, the paper pulley on exciter went to pieces. A cast-iron pulley being on hand, a shut-down of fifteen minutes was recorded. From June 13 to 18, 1904, the switchboard was moved, and all feeder circuits were connected directly on the machine without switches, or fuses, by means of jumpers without a single mishap to cause a shut-down. Last fall one of the screws worked out of one of the split oil rings on pulley end. Not being able to shut down, we ran along with the remaining one until March 28, 1907, when the machine was shut down for three days, thoroughly cleaned out, new oil put in bearings, collector rings turned true, the broken oil ring fixed, and service commenced as usual, Vacouline oil being used during this run. The alternator is belt driven, and an engine located at either side with belt attached in case of emergency. Bearing in mind that this machine carries a continuous overload of 25 to 60 per cent, its record is truly wonderful."

"RED E" SOLDER PASTE.

Electricians, linemen and others have often asked for a convenient solder flux in such form as to be clean to handle and at the same time efficient. Chase-Shawmut Company, Newburyport, Mass., have something that will appeal to everyone, whether at work soldering on the top of a pole or mending a tin pan in the home. The "Red E" Solder Paste, although new to the public, has been used and tested for a number of years by individuals and found in every way satisfactory. For work where only a little paste is needed, such as line, laboratory or shop work, there is nothing as clean or convenient. It is put up in collapsible tubes, so that there is absolutely no waste, and can be carried in the pocket or tool bag with perfect cleanliness. "Red E" Solder Paste is non-corrosive and does not act like an acid but cleans the surface, and acting as a flux makes the solder run freely. Temperature, weather or material makes very little difference. It will keep indefinitely and is "Red E" at any time and in any place. It is put up in two sizes of tubes, one ½x4 inches and the other 1x6 inches long.

"PEROLIN."

A Dustless Sweeping Compound.

Announcement has just been made of recently completed arrangements by which the H. W. Johns-Manville Co., the well-known asbestos firm, with branches in all the leading cities, has acquired the exclusive sales agency for "Perolin" throughout the United States.

"Perolin" is a remarkable product that solves the important problem of preventing the dust and dirt nuisance in public buildings, stores, factories, schools and homes.

In the past various indifferent and unsatisfactory methods have been devised for this purpose. The most common method is to use wet sawdust, or sawdust, sand or salt mixed with crude oil or kerosene. All of these are ineffective. Most of them are highly combustible, and instead of cleaning the floors, leave them in an unsatisfactory condition. Wet sawdust to a certain extent allays the dust, but it leaves the floor muddy. Oily compounds assist in laying dust but leave the floors, carpets and rugs soiled. Oiled floors are condemned by the Fire Insurance Underwriters' Association because of the added fire hazard.

"Perolin" is the ideal fireproof floor-cleaning compound. Instead of laying the dust, it absorbs it. It draws the dust from cracks and crevices in the floors and from carpets and rugs. It is a powerful disinfectant, destroying all disease germs that are common with dust, leaving the air pure and wholesome and the floor absolutely clean.

Sixty-five per cent of all diseases are caused by dust infection. "Perolin" offers the greatest known protection against contagion from this cause. A test was recently made in one of the Chicago Hospitals, to ascertain the number of living germs floating in the air before and after ordinary sweeping, and then after sweeping with "Perolin." Before sweeping the room, it was found that ninety-six bacteria settled on a plate in four minutes. Immediately after sweeping a similar test showed over three thousand bacteria. A test was then made by thoroughly sweeping the room with "Perolin," and only forty-five bacteria were found on the plate.

"Perolin" will not only settle and absorb the dust caused by sweeping, but it will also clean, brighten, and preserve carpets, rugs and floorings, and save curtains, tapestries, pictures and furniture from becoming soiled and discolored. Probably the most common substitute for "Perolin" is wet sawdust. This, however, has several disadvantages. It only lays the dust in sweeping, because the water causes the dust to stick to the sawdust. This dust, remaining on the wet surface of the sawdust, will naturally be smeared all over the floor during sweeping, and this, when dried out, will again circulate in the air, so that no good, so far as removing the dust is concerned, will have been accomplished. Furthermore, wet sawdust will leave dirty streaks on the floor, so that even more scrubbing or mopping is necessary than if nothing were used. It is needless to say that wet sawdust can not be used on carpets.

"Perolin" is the original sweeping compound, having been invented over fifty years ago by a well-known German chemist. It has long been a standard article throughout Germany, and its success there led to its introduction into the United States.

The success of "Perolin" has led to a number of imitations, which, like all imitations, lack the peculiar characteristics of the genuine article. These imitations are made of the ordinary sawdust, or sand, combined with crude oil or kerosene. It is needless to say that they are highly inflammable, and, having no chemical properties, do not act as a disinfectant, or dust absorbent.

EXAMINATION FOR CHIEF ENGINEER.

The United States Civil Service Commission announces an examination on June 26, 1907, to secure eligibles from which to make certification to fill a vacancy in the position of Chief Engineer in the United States Post Office and Court House Building at Chicago, Ill., and vacancies as they may occur in the Custodian Service throughout the United States requiring similar qualifications. The salary of the specific position to be filled will be from $1,800 to $2,500 per annum, the entrance salary to be at $1,800.

The examination will consist of the subjects mentioned below, weighted as indicated:

1. Letter-writing (a letter of not less than 150 words on some subject of general interest. Competitors may select either of two subjects given)	10
2. Practical questions in mechanical and electrical engineering, including the operation of electric elevators, the machinery of electric lighting plants, motors, systems of wiring, and electrical distribution, heating and ventilating, plumbing and sanitary work	65
3. Experience (rated on application form)	25
Total	100

No application will be accepted from anyone who is not a graduate of a technical institution or an engineering college and who has not had at least two years' practical experience in the performance of duties of the character indicated under subject 2 (practical questions). These facts must be set forth in the application. Age limit, 18 to 55 years on the date of the examination. All honorably discharged United States soldiers and sailors of the war of the rebellion will be admitted to this examination without reagrd to the maximum age limit. Applicants should at once apply either to the United States Civil Service Commission, Washington, D. C., or to the Secretary of the Board of Examiners, for application Form 1052.

An examination will be held on June 26, 1907, to secure eligibles from which to make certification to fill vacancies as they may occur in the Custodian Service throughout the United States in the position of first-class steam engineer, at salaries ranging from $1200 to $1600 per annum.

Also an examination on June 26, 1907, to secure eligibles from which to make certification to fill a vacancy in the position of assistant engineer (qualified as electrician), in the office of the Secretary of War, at $720 per annum, and similar vacancies as they may occur.

INDUSTRIAL.

H. M. Byllesby & Co. of Chicago have been retained as consulting engineers for the Sioux Falls Light and Power Company, of Sioux Falls, South Dakota. A water power with a head of about eighty feet is to be constructed on the Big Sioux River at this point. They have also been retained as consulting and operating engineers for the Flathead Valley Water Power Company, of Kalispell, Mont. The Company's water power is situated at Big Fork, Montana, on the Big Fork River, having a head of about 105 feet. This development is to be added to, and the capacity of the plant greatly increased."

North Yakima, Wash.—The Yakima Gas Company, in which a number of residents are financially interested, has gone under the control of the gas trust and a mortgage for $100,000 upon its plant was registered today in favor of the Germantown Trust Company of Pennsylvania. Ira P. Englehart, attorney for the company.

NEWS NOTES

ELECTRIC RAILWAYS.

Spokane & Inland Empire Electric System.—J. B. Ingersoll, general manager, announces the opening of passenger service from Oaksdale to Garfield and Palouse, twenty-five miles. The lines will be extended southward until they reach the Snake River. With the opening service to Palouse the company is operating eighty-one miles of road, seventy-six from Spokane to Palouse and five on the western division, Spring Valley to Rosalia. This is forty-four miles now in operation by the Spokane Traction Company and makes an aggregate mileage of one hundred and fifty for the system.

Inland Power and Electric Company.—This concern, incorporated a year ago, purposes to build an electric line between Spokane and Newport, fifty-six miles, to be in operation in two years. Mrs. M. E. Goddard of Spokane and her son, Fred Goddard, a civil engineer, are among the foremost of those interested in the project. Thomas Payne of Detroit, Mich., is also identified with the company. The company has secured the site for a power plant at Albany Falls, on the Pend d'Oreille River, a mile northeast of Newport, where work will begin as soon as the low-water period begins.

Great Northern Railway.—M. R. Shellar, government forestry supervisor, has gone to the Cascade tunnel near Leavenworth, Wash., west of Spokane, for the purpose of cruising the timber on the right of way on which the Great Northern desires to place wiring from Leavenworth to the tunnel. It is intended to supplant steam with electricity for hauling through the tunnel, and thus obviate the great discomfort and risk of steam and gas to the traveling public. He will inspect the Wenatchee River at the location decided on by the Great Northern for dams, embracing the width of the river, thus impounding the water at these points, generating 7000 horsepower, which will be used principally at the Cascade tunnel.

Panhandle Electric Railway & Power Company.—Thomas W. Payne of Detroit, Mich., A. J. Smith of Spokane, Andrew Coolin of Priest River, Harry H. Wallace and John R. Jones of Spokane have organized a company to build an electric line in the Priest Lake country, northeast of Spokane. The project will be carried out by Eastern capital. The power will be generated at a plant to be constructed below the outlet of Priest Lake in the Priest River valley. A flume is planned from the lake to a point down the valley where the greater power can be obtained. The lake will be turned into a reservoir so that the flow can be equalized throughout the year. The line will tap timber belts and mining districts, giving heavy tonnage.

Big Bend Transit Company.—W. A. Nichols of Spokane, who has charge of the financing of the company, announces that grading on the line between Spokane and Bar Landing on the Columbia River has been completed for seven miles, and preparations are now being made to hurry the work as much as possible. All the grading work on the military reservation has been completed to comply with the terms of the grant made to the company, and a crew of men with teams is now working up the river. H. U. Wallace of the Wallace-Coates Bridge Engineering Company of Chicago is now in Spokane representing Eastern people who are interested in the new road. He said after an inspection trip: "I believe it is the most practical route that could be selected, as there is a water grade all the way, and no other road in the territory could compete with it."

Spokane and Inland Electric System.—Eight palace coaches from the shops of the J. G. Brill Company at Philadelphia have reached Spokane for use on the Coeur d'Alene division, thirty-four miles. The new equipment consists of two 3-car trains and parlor cars. The trains are made up of a No. 1 motor coach with smoking and baggage compartments, and are finished in mahogany and rattan. The No. 2 coaches also have motors and are finished in mahogany and plush and have comfortable high-back seats. The seating capacity of No. 1 is fifty-six, of No. 2 is sixty-six, and No. 3 carries seventy-five persons. It is fitted with an observation platform. The cars are fifty-seven feet and are of a dark-red exterior. The trains will be equipped with eight 100-horsepower motors and will be capable of drawing two extra coaches. The motors are geared sixty-five miles an hour.

Columbia & Wallula Railway.—H. U. Wallace, of the Wallace-Coates Engineering Company, Chicago, has been sent to Dayton, Wash., west of Spokane, by an Eastern bonding company, which has under consideration the financing of the Columbia & Walla Walla electric line from Dayton to Wallula, via Walla Walla and Milton. Mr. Wallace made a trip over the line recently surveyed for an extension to Pennewawa on the Snake River, and made an inspection of the power facilities on the upper Tucannon, where there is a natural waterfall of 300 feet, capable of developing several thousand horsepower, which can be made available at a small cost. He believes the road is feasible. The right of way between Dayton and Wallula has been secured. The survey from Dayton to Pennewawa, fifty miles, is taken to mean that a connection with the Spokane and Inland Empire line from Spokane to that point is contemplated.

Pullman, La Crosse & Columbia River.—J. O. Staats of La Crosse, has submitted a proposition to the people of Whitman County, Wash., south of Spokane, to organize a railroad company and build an electric line from Pullman to La Crosse and Hooper, to be called the Pullman, La Crosse & Columbia River Railroad, forty-two miles. It is to connect at Pullman with the Oregon Railroad & Navigation Company and at Hooper with the new Portland-Seattle branch of the Northern Pacific. The route will be from Pullman to Union Flat, via Wilbur Gulch, thence crossing the flat to Little Pennewawa Creek, thence down that creek and across the divide to Alkali Flat, thence to La Crosse, via Willow Creek. Power will be generated at Palouse Falls, near Washtucna, if sufficient force can be obtained. If not, steam will be used. The proposed line will occupy almost the route selected by the Northern Pacific several years ago when it was proposed to build a cut-off to connect with the main line near Pasco, thus saving a long haul to Marshall Junction and back to Pasco. The line will be 130 miles shorter than the road now running from Pullman to Pasco via Marshall Junction.

TELEPHONE CONSTRUCTION.

Fort Benton, Mont.—The Benton-Highwood Telephone Company has ordered material for a double line on the Shonkin.

Auburn, Wash.—The Sunset Telephone Company is fitting up the Howard Building for city exchange and will place two expert operators in charge.

Spokane, Wash.—The Home Telephone Company have purchased a lot on Augusta Avenue, between Monroe and Lincoln Streets, and will build a $50,000 building for subexchange.

Bellingham, Wash.—The Sunset Telephone Company has opened a service to Maple Falls by connection with Maple Falls Telephone Company; has also opened Crescent No. 2 line along the Lynden road, and will construct a line from Maple Falls to Glacier at once.

POWER AND LIGHT.

Albion, Idaho.—Board of Trustees of the Albion State Normal School will receive bids for the furnishing and installing of a complete electric lighting plant for the normal school at Albion, Idaho, until June 4.

Tacoma.—An underground cable from A Street up the hill on Fifteenth Street to Pacific Avenue, to assist teams in hauling heavy loads from dock streets, is asked for in a petition for a franchise by George Scofield and Calvin Barlow.

Conconully, Wash.—It is the intention to put two water wheels of the submerged type in the river at Okanogan the present year. One of these will be used by Captain Bureau to run his planing mill. The other will operate a dynamo to generate power for electric lights and be installed by F. W. Rosenfelt.

Weiser, Idaho.—Engineer A. E. Fox returned from Ox Bow, where he has been employed by the Ox Bow Electric Power Company, surveying the route of the transmission line from Ox Bow to Boise. The line has been practically decided upon. The main line will run near this city, just at the foot of the hills back of the institute and academy. A branch line will run from the main line to Weiser to furnish power to the city. Delivery of poles along the line will begin shortly. A large number will be delivered here for distribution along the route.

Portland.—With the growing importance of the East Side has come a rearrangement of power in that district by the Portland Railway, Light & Power Company. Prior to the completion of the new sub-station on Knott Street, near Williams Avenue, power for lighting and all other purposes was furnished from the West Side sub-station at Seventh and Alder Streets. With the installation of this new distributing station, power is brought to it directly from Oregon City and Cazadero generating plants, as well as from the steam-power station in North Portland. The East Side is now wholly independent of the West Side in power supply.

Walla Walla, Wash.—Twelve cars of new machinery have been ordered by the Northwestern Gas & Electric Company for its gas plant, and after it has been installed Walla Walla will have one of the largest and most modern gas plants in the entire Northwest. The machinery ordered includes a new gas tank or holder, which will have a capacity of 100,000 cubic feet of gas. This tank is larger than the one the company has at present and will be erected just south of where the present tank stands and just north of Mill Creek. A tar extractor, condenser and compressor have also been ordered and have a capacity of 300,000 feet per day. The company intends to have this machinery installed and ready for use some time this summer, and the work of putting it up will commence as soon as it arrives.

Washington Water Power Company.—One million dollars will be expended by this company in harnessing the upper falls in the Spokane River in Spokane, the purpose being to double the horsepower now available. Clifford S. MacCalla, assistant manager, announces that a 30,000 horsepower plant will be installed, the work occupying from three to five years. It will begin as soon as its auxiliary steam plant at Ross Park is completed next fall. The completion of the before-mentioned plants will give the company 84,000 horsepower. The company has just completed 9000 horsepower plant at Post Falls, where another unit will be installed to measure the capacity of 12,000. The plant cost $750,000. The Ross Park power house is valued at $2,000,000 and the upper falls works at $1,000,000. In addition to this $2,000,000 will be expended in putting the wires underg nd. The energy will be used for lighting and heating, operating drills in the mines of Northern Idaho, 110 miles east of Spokane.

ELECTRIC RAILWAYS.

Helena, Mont.—Helena Light & Railway Company will soon commence work on the State Street extension.

Conconully, Wash.—Okanogan Electric Railway Company is surveying for line from Nighthawk to Brewster.

Butte, Mont.—Butte Electric Railway Company has been granted a franchise to extend its line on Walnut Street for six blocks.

Bellingham, Wash.—Canadian Pacific Railway Company has a crew of engineers surveying for an electric line from Sumas to Bellingham.

Eugene, Ore.—Willamette Valley Company has received a large consignment of machinery and tools and will at once begin construction of its line in this city.

Marshfield, Ore.—The Coos Bay Electric Railway Company, with a capital of $100,000, is being organized to construct a line from Marshfield to Coos Bay and work will begin at an early date.

Freewater, Ore.—Walla Walla Valley Traction Company will extend its Milton line as far as Milton City Park where it will make a loop running on portions of First, Mill, Union, Cherry and Thorn Streets.

Olympia, Wash.—Pacific Traction Company has applied to the City Council for a franchise over certain streets, and building of the line between American Lake and Olympia will begin as soon as rights of way are secured.

Everett, Wash.—President Rowse of the Cascade Valley Railroad Company says his company will have survey completed from Rockport to Cascade Pass in two months and construction will begin immediately. The line will be forty miles long.

Boise, Idaho.—Idaho Water & Electric Power Company, $500,000, by J. L. McClear, P. J. Scallon, and Maud Thornton of Coeur d'Alene. The company will build sixteen dams on the St. Joe River to develop electric power for use of C. M. & St. P. in getting trains over Bitter Root Mountains. Cost of dams, exclusive of power plants, will be $923,000.

MUNICIPAL.

Georgetown, Wash., Water. — President Paul of the Georgetown Water Company says the mains of the company from Weir Springs will be enlarged to 8-inch soon.

Georgetown, Wash., Gas. — The Georgetown Council passed the franchise granting to the Seattle Lighting Company the right to manufacture and distribute gas in the suburb for the next forty-four years. It agrees to lay two miles of distributing mains before July 31, 1908.

NEWS NOTE

Napa, Cal.—Another application for a franchise to erect and maintain poles and wires over the county roads for transmitting electricity for power, lighting and heating purposes, has been made to the Board of Supervisors. The application was made in the name of O. L. Beard and the right of way requested corresponds with that granted Henry Brown, the banker, some weeks ago. Both parties are supposed to represent the same company, and it is thought that the last application was made to cover some point omitted in the former. The fact that a franchise has been asked for in Sonoma County has given rise to a rumor that the Napa County proposition is in the control of the same parties as the Sonoma County franchise.

TELEPHONES AND TELEGRAPHS.

Hoquiam, Wash.—The City Council Friday night declared the Ed. C. Finch telephone franchise void, alleging Mr. Finch had not lived up to the agreement of the franchise ordinance

La Center, Wash.—La Center & View Telephone Company of La Center, $1500, by George W. Lawton, O. F. Shintaffer, J. D. Poole, C. R. Tyner, C. F. Myers, and B. F. Anderson.

North Yakima, Wash.—J. P. Reed, representing the Independent Telephone Company, announces that he will apply for a franchise for his company at the next meeting of the council. It is the intention of the company to make North Yakima the headquarters for Eastern Washington.

Condon. Ore.—Last week L. C. Lawrence of the local telephone service purchased a half interest in the Condon system from Louis Doonar and $1500 is said to have been the price. Mr. Lawrence is an experienced line and telephone man and intends to put the system in good order and improve the present service.

Washington, D. C.—Bids have been received by the chief signal officer of the army for equipment for the proposed wireless telegraph station to be established at Fort Gibbon, Alaska. Six firms competed for the contract, the bids ranging from $7000 to more than $10,000. It has been decided, however, to reject all bids, as it will be impossible to secure the material in time for shipping in this summer. New bids will be called for in the fall. The signal corps has purchased two steel masts to be used at the new wireless station at Circle and Fairbanks. Each tower is to be 200 feet high.

Redding, Cal.—The Shasta Power Company has agreed to permit the Forest Bureau to connect with its telephone line. The Bureau is building telephone lines in the eastern part of the county to serve as a fire alarm system. The Shasta Power Company owns a line from Redding to the head of this ditch on Hat Creek, a distance of 40 miles. The Bureau couples up with such private lines when it is possible to do so, and fills in the gaps with wires of its own. The forest belt in the east of Shasta County will be covered with wires and fire alarm stations. Connections will be made as far north as Sisson and McCloud.

Reno, Nev.—That the Western Union Telegraph Company does not intend to relinquish the business it has built up in the southern part of the State without a struggle is evidenced by its active plan of extension and improvement already started. Engineers have been placed in the field to survey a route from Tonopah to Ely to connect with the main lines along the right of way of the Southern Pacific. The plan of improvement also includes the installation of heavier wires between here and the southern country. This work will be commenced to meet the opposition threatened by the active operations of the Postal Telegraph people to enter Nevada.

San Francisco, Cal.—Amended articles of incorporation of the Home Telephone Company have been filed with the County Clerk recently. They were amended in order to conform with the provisions of an act of the last Legislature providing the corporations may issue both common and preferred stock. The Home Company will issue both. The new Board of Directors, as shown by the articles which are signed by the owners of two-thirds of the capital stock, are Mark L. Gerstle, Louis F. Beedy, L. H. Baily, W. H. Parkhurst, Jr., and C. F. Mohler. Henry T. Scott withdrew in 1905, when he went to the Pacific States Telephone and Telegraph Company; John J. Mahoney, Vanderlyn Stow and R. M. Hotaling have been superseded by Beedy, Baily, Smith, Ochiltree, Parkhurst and Mohler. J. S. Torrance remains as treasurer. The capital stock remains as before—$10,000,000—but it is divided into $5,000,000 preferred and $5,000,000 common.

FINANCIAL.

San Francisco, Cal.—The Home Telephone Company has filed with the County Clerk a certificate of bonded indebtedness for the sum of $10,000,000. The issue of the bonds, which are for $1000 each, bearing interest at 5 per cent for forty years, was voted at a meeting of the directors held May 28th. The Union Trust Company will handle the issue.

Pasadena, Cal.—The city administration is now sounding public sentiment to see what chance there is of getting the people to vote additional bonds for either the completion of the municipal electric light plant as at present planned or for enlarging it as Superintendent Glass recommends. It will take $23,000 to complete the plant as planned on the 500-kilowatt basis. Glass recommends a plant of 1000 kilowatts, which would cost $110,000.

Sacramento, Cal.—The present trip East of President H. A. Butters, of the Northern Electric Railway Company, was made to finance the plans of the company to take over the Vallejo and Northern Railway Company. The latter concern is incorporated to build a double track interurban line 105 miles long from Sacramento to Vallejo. It is also to establish with San Francisco from the Navy Yard city. A contract for two steamers to ply between Vallejo and San Francisco has been let by the Northern Electric Company, and the road between Sacramento and Vallejo will be opened for traffic by Christmas of 1908. Melville Dozier, the promoter of the Vallejo and Northern, is now in Sacramento consulting members of the local board of trustees in reference to his local franchises. The Vallejo and Northern and Northern Electric have united in a request for permission to build a bridge across the Sacramento River at M Street.

INCORPORATIONS.

Los Angeles, Cal.—The Porter Ranch Oil Company has been incorporated here with a capital stock of $500,000. The incorporators are S. C. Hell, J. W. Squires, Frank Garlett, and J. L. Murphy.

San Bernardino, Cal.—The Delta Water Company has been incorporated at Redlands with a capital stock of $50,000, of which half has been subscribed by Arthur Gregory, J. D. Langford, and M. C. Butterfield.

Bakersfield, Cal.—The Utah and Bakersfield Oil Company has filed articles of incorporation, with a capital stock of $500,000. The directors are W. O. La Grange, J. W. Brisco, W. T. Davis and others.

Los Angeles, Cal.—The Fremont Oil Company has been incorporated here with a capital stock of $500,000. The incorporators are C. M. Gordon, F. Winstanley, H. M. Mosher, J. J. Freeman, R. A. Wickenden, and others.

Los Angeles, Cal.—The Jordan Oil Company has been incorporated here with a capital stock of $100,000. Those behind the company are H. O. Courtney, C. H. Landers, George E. Mills, F. M. Allen, and M. F. Grant.

San Luis Obispo, Cal.—The Lucerne Oil Company has been incorporated here with a capital stock of $500,000. Shares are $1 each. The directors are E. Righetti, of Orcutt, and Peter Tognazzini, and others of this place.

San Francisco, Cal.—Articles of incorporation have been filed by the Moun[illegible] Springs Water Company with a capital stock of $50,000, shares $100 each. Those backing the enterprise are Edwin Schwab, W. C. Webb, and R. M. Sims.

POWER AND LIGHT.

St. Helena, Cal.—Henry Brown, the banker of Napa, has applied to the trustees here for a franchise to bring his power line into the city, and his petition was granted. He states that he will apply to Vallejo and Calistoga also.

Merced, Cal.—Sidney Sprout, the electrical engineer and supervising engineer for the Ocean Shore Railway, is in Merced looking over the plant of the Merced Falls Gas & Electric Company with a view to determining on certain improvements to be made in the property in the near future.

Willows, Cal.—C. R. Wicks, one of the promoters of the Snow Mountain Power Co., of Glenn County, says that the preliminary work of this concern has commenced and will be rushed as rapidly as possible until the plant is in readiness to supply power to this and the neighboring counties. W. Meredith, an electrical engineer of the firm of Hunt, Dillman, Meredith & Allen, of San Francisco, has left for the site of the works, accompanied by Jack Campbell, M. J. Boggs and J. B. Sweet, all of whom are interested in the large concern. Meredith has been engaged by the company to draw up complete plans for the electrical plant, and it is expected that it will take in the neighborhood of two weeks to finish the work. Wicks states that he has obtained permission from the Forestry Department to build a road from Fouts Creek to the proposed site. The road will be the first step, owing to the fact that it will be impossible to haul material without it. Wicks, Glenn and Lindstrom, the prime movers of the scheme, has purchased an interest in the Morris sawmill. This mill will be worked to its fullest capacity to furnish lumber for the new company. At the June session of the Glenn County Board of Supervisors the firm will ask for a franchise to stretch and maintain wires and furnish power in Glenn County. The company has concluded to incorporate with a capital stock of $500,000.

TRANSPORTATION.

Los Angeles, Cal.—For $100 the City Council sold a franchise for the Bimini Baths line last week. A franchise was also awarded to Walter Brown for an electric car line on portions of Third Street and Vermont Avenue.

Oakland, Cal.—The Board of Supervisors granted a franchise last week to the Oakland Traction Consolidated to lay tracks and operate a line of electric railway in Fruitvale. The proposed road begins at Over Street, runs along it to Boulevard Avenue, along the latter to Liese Avenue, and thence to Fourteenth Street. The Oakland Traction Consolidated paid $500 for the franchise.

Salinas, Cal.—It has been determined by the Spreckels interests to build a railroad between this place and the town of Spreckels. A corporation will be formed by the Spreckels Sugar Company for the purpose of building the road, which is to connect Salinas with the Pajaro Valley Consolidated Railroad. A suit in the Superior Court will soon be instituted to secure a right of way over the property of the Trescony estate, which is owned by minors.

Reno, Nev.—Material has been ordered by Manager Campbell, of the Reno Traction Company, for the extension of the lines from Fourth Street in the business center of the city to Ninth Street along Sierra Street, and thence to the gates of the University of Nevada. This work is expected to be completed by June 15, and then the cars will run from the business section of the city to the University grounds. While the Reno Traction Company is improving its system, it will extend its line for a mile on South Virginia Street to connect with the line of the Reno Development Company, which is now building through a new suburban tract south of Reno. Later the line of the latter corporation will be extended to Steamboat Springs.

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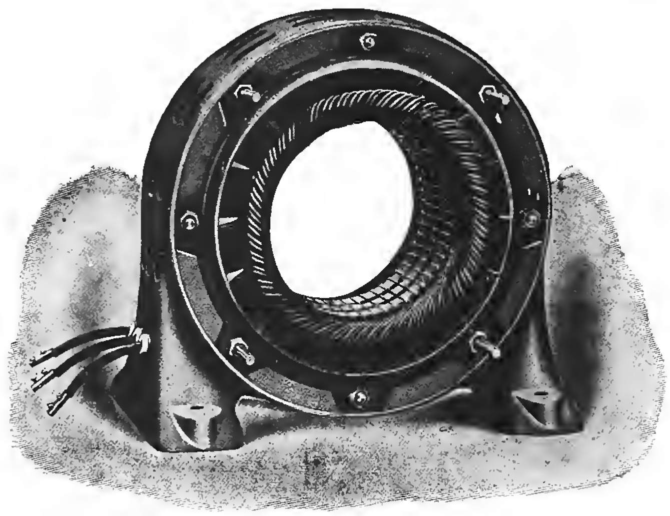

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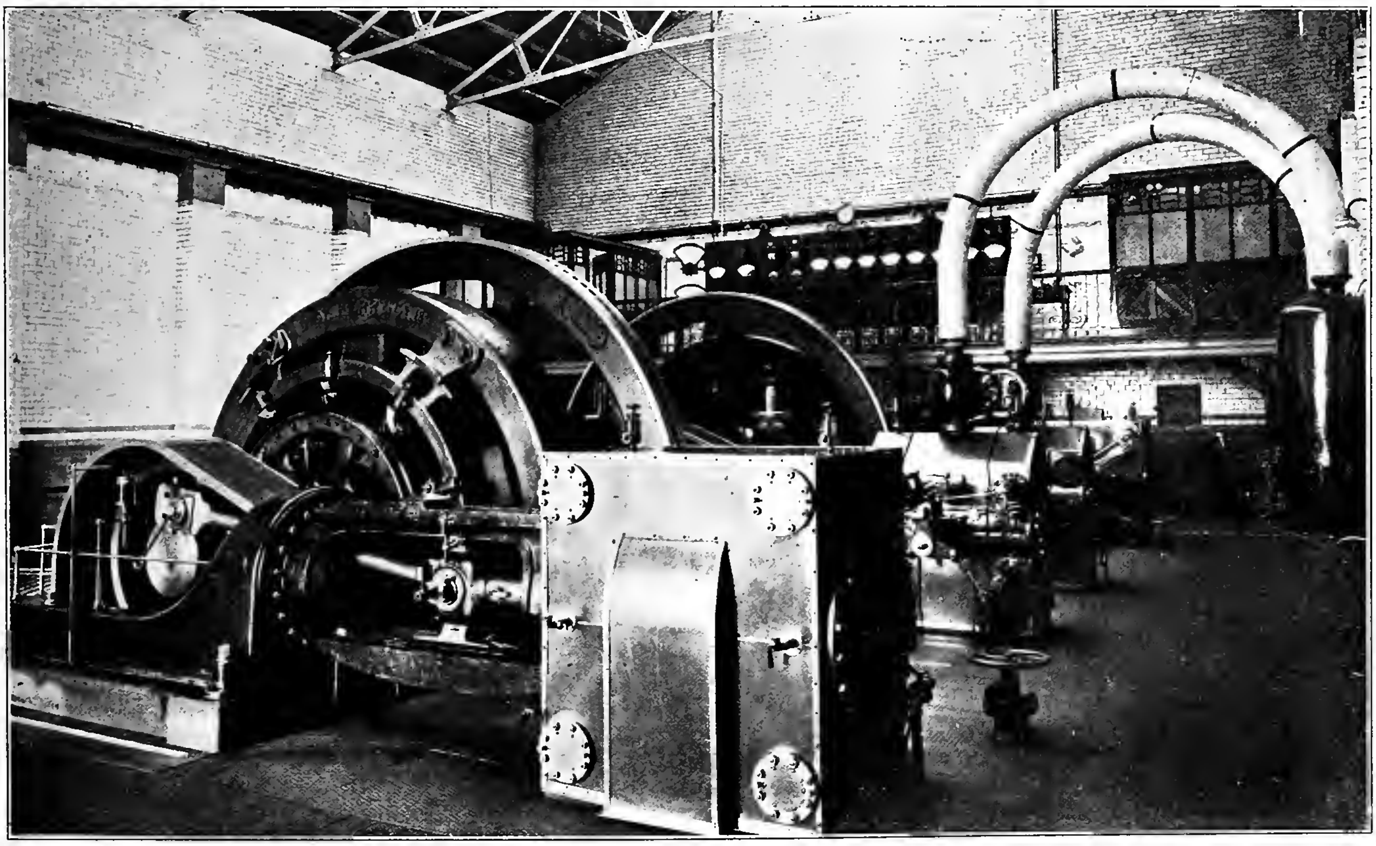
ELECTRIC LIGHTING AND RAILWAY SERVICE WITH CITY REFUSE

The accompanying illustration shows the Fulham Electric Works at London, S. W., where a refuse destructor is employed and the power utilized for driving electric lighting sets, the clinker being made into paving stone and slabs as shown in the illustration. At this plant 145.6 indicated horsepower hours are obtained per ton of refuse, with 120 tons destroyed per day of twenty-four hours in the twelve destructor cells of the back-to-back top-feed type employed. The boiler equipment consists of a half-dozen water tube boilers of the Babcock & Wilcox type, together with economizers and steam blowers for force draft.



PRESTON ELECTRIC RAILWAY POWER HOUSE SUPPLIED WITH STEAM FROM MELDRUM REFUSE DESTRUCTOR PLANT

Municipal authorities throughout the world have been making a careful study during the past decade of the question of how best to deal with the refuse of their various communities, and in these days of inventive genius and general development of labor-saving devices there has been wonderful municipal progress along these lines. The treatment of waste matter of cities and towns is now considered not wholly an expense, since the systematic and scientific burning of such refuse may make it a valuable asset in the generation of steam for the production of electric current for lighting the streets and public buildings as well as for power for electric traction.

Such scientific treatment of waste refuse not only secures more healthful and sanitary conditions for the inhabitants, but it may also be utilized in addition to the above service for supplying power for pumping water and sewage, while the cinders as by-product are utilized to advantage for pavement slabs, bricks, mortar, and the balance for concrete.

Until recently in most places the open tip was the usual receptacle for refuse and it was allowed to lie exposed to the varying atmospheric conditions of the climate, the hot sun beating upon it during the day, causing offensive odors to rise in the evening. Undoubtedly this has been responsible for many diseases. The introduction of the destruction of refuse by fire has entirely obviated these difficulties wherever used.

More than two decades ago the city of Preston, England, installed its first refuse destructor, consisting of a row of eight cells of the top-feed variety with natural draft and this equipment served its purpose for several years when a second refuse destructor plant was installed, consisting of

twenty cells of the same kind of the Manlove, Alliot & Fryer type. These were placed back-to-back and fitted with a Jones' fume cremator, and the combined plants handled the city's refuse collection for another decade, when it was found that they could not cope with the whole output. The scavenging committee, being unwilling to resort to tipping, visited many operating destructor plants, paying particular attention to thorough cremation and methods of feeding.

The new refuse destructor decided upon was of the front-feed type, the authorities maintaining that the top-feed isolated cells were responsible for the emission from the chimney of unconsumed vapors and for varying temperatures taking place in the furnace chambers. They were also impressed with the intense heat developed in the process of cremation and with the power which it was possible to produce with the front-feed grate system of destructor.

The electrification of the Preston street railways was under consideration, and after conferences between the scavenging and tramway committees of that English city it was decided to erect the two stations side by side in order to utilize the steam power generated by the refuse destructor for electric traction.

The wisdom of this decision has been demonstrated by the successful operation of the Preston electric tramways with power generated by the destruction of the town's refuse in an up-to-date destructor plant.

The destructor installation includes four Meldrum regenerative furnaces of the four-grate simplex type, each unit having a total grate area of one hundred square feet, the plant being so arranged that any pair of the units can work together with special attention being paid to cleanliness, convenience of operation and the saving of labor.

As the carts of refuse arrive at the destructor plant they are backed against a long tipping sill and shoot their loads of refuse into four steel hoppers, each having a capacity of forty tons and thoroughly protected from the weather.

The refuse handled by this plant differs greatly from that of American cities, where the wet garbage and refuse is usually kept separate from the dry rubbish such as paper, rags, ashes and wood. At the Preston destructor plant the refuse is of a miscellaneous character, consisting of dry and wet ashes with a sprinkling of excreta, offal, both animal and fish, together with condemned meat, game and poultry. About twenty thousand tons of refuse is disposed of per year, or an average of fifty-five tons per day, and this does not include about twelve tons of fish, offal and nine carcasses per week, including horses, cows, sheep, pigs and calves.

It is remarkable that this destructor, while operating the electric street railways of this English city, at the same time cremates these carcasses, utilizing even this material for generating power, while the residual, amounting to thirty per cent and consisting of excellent hard clinker, is found especially suitable for road foundation and other municipal purposes and provides a considerable source of income.

After passing the tipping platform and entering the destructor, a wide corridor is noted, on one side of which is located the outlet of the hoppers, and on the other side the furnaces. A stone still is provided on which the refuse falls from the hoppers, and it is charged by the fireman by hand through the front doors of the furnace, the fire being regulated to suit the material. The authorities at Preston advocate the hand feed as the most satisfactory, claiming that it combines efficiency and economy with a most perfect combustion of the material and an avoidance of all disagreeable odors.

There is a large furnace chamber covered with one continuous arch with the simplex arrangement of grates, and on looking into the furnace it appears to be one length of fire bars with four door openings at the front, while it is in reality divided into four compartments by brick walls carrying inverted C. I. Tees with their edges level with the surface of the fire bars.

Each compartment of the ash pit contains separate force draft accessories, consisting of steam jet blowers and the gases of combustion traverse the furnace in the direction of its length.

The burning gases leave at one end through an arched opening in the wall dividing the furnace and combustion chamber, most of the dust settling in the latter, while the gases are drawn to the boiler outlets lying at the further end of the chamber.

It is claimed that there is an absolute cremation of all noxious vapors, it being difficult most of the time to ascertain from the appearance of the chimney whether the plant is in operation or not. It is held that this absolute cremation of the refuse is insured by the continual mixing of the gases in the furnace and combustion chamber while they are subjected to the radiant heat of the brick work, maintained in an incandescent state.

At the Preston refuse destructor plant two of the four units are provided with an offal hearth, and the gangway is at a convenient level from the tipping platform, serving the purpose of unloading butcher's offal and fish, this being dumped down a brick-lined tube on a concave hearth. It is exposed to the fire and the gases that are given off must necessarily pass over the whole length of the fire grate and are entirely consumed. In this way the carcass of a horse may be disposed of without in any way impeding the efficiency of the destructor, every part being cremated, even the bones aiding in the generating of steam and only the horseshoes and nails being found in the clinker. The whole carcass is dealt with without handling, as the two other units have an electrical opening in the top of the combustion chamber and mechanical equipment is provided for handling these heavy weights. The Board of Agriculture requirements makes is necessary that the destructor furnaces deal with whole carcasses of animals affected by such diseases as anthrax and glander. It is unnecessary for a man to approach the opening in the furnace, as the carcass is lifted directly from the cart by a traveling trolley operated at the platform end with a device for releasing the carcass below the opening of the furnace.

Having considered the destructor furnaces of the Preston plant, it may be of interest to consider the construction of the boiler engine and electrical generator installation. There are four boilers of the Lancashire type, and the gases after leaving the combustion chamber pass into these boilers, having reached the heat of about 2000 degrees F. The boilers are eight feet in diameter and thirty feet long, and are designed for a working pressure of 200 pounds per square inch. They are each connected to the combustion chamber by means of three steel tubes lined with fire brick, and the gases pass through the boiler in the same manner as in a coal-fired boiler. It is maintained, however, that the temperature is more constant than with a coal fire, and consequently there is less fluctuation in the steam pressure of the boiler, which is very desirable at an electric power station. It is stated that the constant high temperature in this type of destructor furnaces is attributed to the fact that only one portion of the grate is being charged or being cleaned at a given time, the others being in an incandescent state, thus insuring the rapid ignition of each fresh charge. This evenly high temperature insures a high evaporative duty in the boiler without in any way sacrificing the perfect destruction of the refuse.

One of the most interesting features of this Preston destructor plant is the regenerator through which the gases pass after leaving the boiler, and consisting of a nest of pipes. The air for combustion is drawn into the ash pit at a temperature of 400 degrees F., becoming heated by circulating around these hot tubes. There is no question but that there is great value in the utilization of the hot gases

coming from the boiler in this manner when consuming waste refuse which is a fuel of low calorific value.

As a dust catcher the regenerator is said to have proven very efficient, the dust which passes through the boiler flues being trapped and deposited beneath the tubes in the pit.

It is advantageous where continuous power is necessary for electric street railway and other similar service that duplicate flues be provided for the gases passing from the regenerator so that the plant may be worked without interruption, and at Preston a complete duplicate plant has been installed. Green economizers are employed arranged in three groups, eight pipes wide, with 288 pipes altogether. An engine is provided for operating the scrapers. The economizers are only utilized on heavy loads, a by-pass flue being provided, while there is a damper to shut off the entire plant if required, there being a special locking gear on the dampers which renders it impossible for the pull of the chimney to close any of them.

The sanitary department has nothing whatever to do with the electricity department of the city of Preston, and the former, having generated the steam at the destructor station, sells it to the electric tramway department of the municipality.

It will be noted that the city refuse in its destruction is very advantageously used for supplying steam for operating the electric railway, horizontal cross-compound engines being used, each having a maximum output of 520 horsepower. While this plant was under construction, it was maintained by many that sufficient power could not be obtained for operating the railway, but it may be stated that the Preston refuse destructor supplies the tramway department with sufficient steam to generate 20,000 units a week.

This was found to be sufficient to operate the Preston electric tramways over ten miles of streets, with a length of track of sixteeen and one-half miles. Electric power is also supplied from this waste refuse for lighting the car sheds and workshops as well as the destructor buildings and also supply steam for a large Jeffries disinfector.

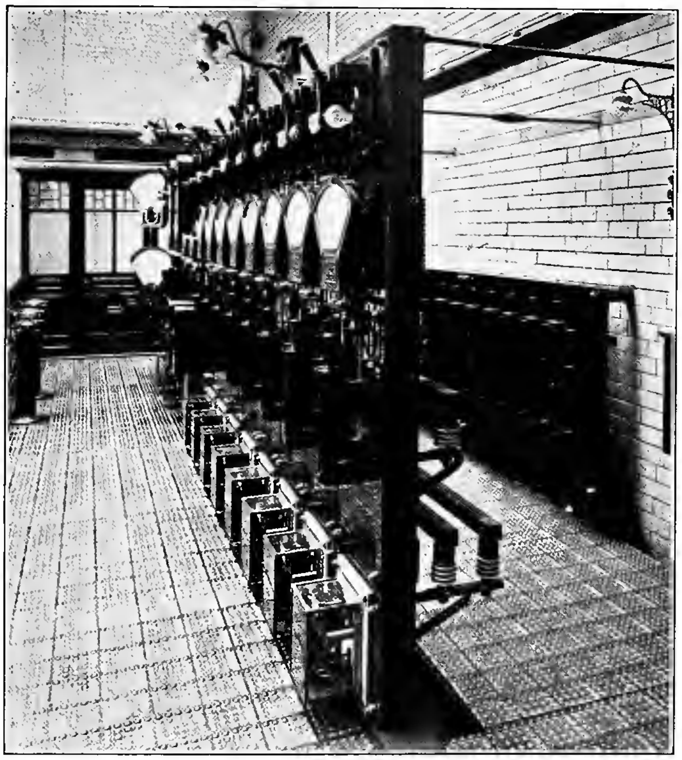
The Preston corporation tramways are supplied with current from a municipal power station, having a supplementary boiler house for reserve in addition to receiving steam from the refuse destructor plant adjoining. This boiler house and pump room is about eighty feet square with space for four boilers, although two Lancashire boilers were installed thirty feet long and eight feet in diameter. The stoking floor is twelve feet wide and runs the whole length of the boiler house. The boilers are designed for working at a pressure of 160 pounds and are each provided with a Bolton superheater placed in the downtake, which is designed to superheat the steam from the boilers to a maximum of 100 degrees above that of the working pressure. An electric motor is utilized for working the scraping gear of a Green economizer, consisting of 256 tubes. There are also two vertical tubular feed water heaters each of 104 square feet effective heating surface.

Electric power is largely used for the auxiliary machinery, a single reduction electric motor with rawhide spur gearing being utilized in the pump room for driving a three-throw, single acting feed pump, having an output of 1000 gallons per hour at a speed of 100 revolutions per minute. There is also a direct acting steam feed pump capable of delivering 750 gallons per hour, and a hot well and feed tank beneath the floor of the pump room having a depth of five feet and covered with steel plates.

The electric railway engine and generating room is 37½ feet high, 55 feet wide, and 83 feet long. Provision has been made for two 300-kilowatt units and one 500-kilowatt set, the former being installed on foundations of solid concrete 12 feet deep and 48 feet long by about 26 feet wide.

The two 300-kilowatt compound wound railway generators which have been installed and in successful operation for some time are of the Dick Kerr construction and are driven by horizontal compound engines built by Cole, Marchanz & Morley of Bradford, England. These engines drive the direct current dynamos at a speed of 100 revolutions per minute and have fly-wheels weighing fourteen tons and measuring sixteen feet in diameter. The high-pressure cylinder is seventeen inches in diameter and is fitted with Corliss valves and automatic cut-off motion operated by the engine governor. The stroke is thirty-six inches and the low pressure cylinder which is thirty-four inches in diameter is also fitted with Corliss valve gear, the cut-off of which can be varied by hand while the engine is in motion. The crank shaft is fifteen inches in diameter and is of high-grade steel, and each engine is fitted with permanent indicator motion to each line of cylinders, together with all the necessary apparatus and cocks.

During the official trials of this electric power-house equipment, the combined efficiency of the engine and generator was found to be 85 per cent, the consumption being 12.25 pounds of steam per indicated horsepower and 19.5



SWITCHBOARD OF PRESTON ELECTRIC RAILWAY POWER PLANT

pounds of steam per kilowatt hour measured at the terminals of the generator.

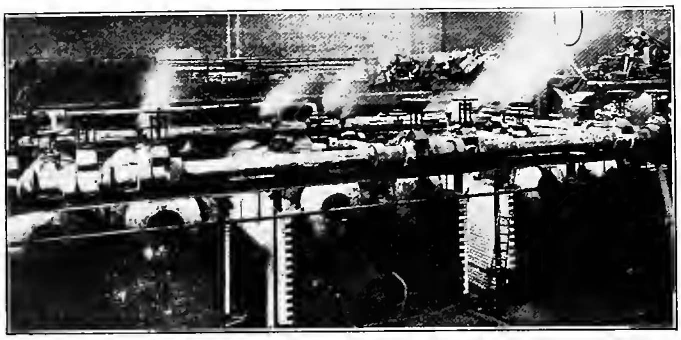
A cooling tower was provided, having an effective cooling area of 70,000 square feet and an internal capacity of 8000 cubic feet, the tower being 43 feet high, 21½ feet long and 11½ feet wide, and two cooling fans installed on steel girders, each 9 feet in diameter. A 10-horsepower electric motor is used for driving each of these fans at a speed of 110 revolutions per minute, the capacity of each being 62,000 cubic feet of air per minute. For cooling water the town's supply is used, and a 55-horsepower electric motor is employed for driving the complete condensing set, the circulating pump being of the centrifugal type capable of delivering 50,000 gallons of cooling water per hour to a vertical height of 46 feet to the cooling tower.

At one end of the engine room the switchboard and accessories are mounted on a platform, the board of the Ferranti design consisting of eleven black enameled slate panels two inches thick. There are eight feeder panels, a Board of Trade panel and two generator panels equipped with the usual

ammeter, voltmeter and recording ampermeters, also automatic circuit breakers, double throw switches, wattmeters and lightning arresters and choke coils.

Below the switchboard gallery there is a booster set provided, consisting of one 20-horsepower shunt wound motor directly coupled to one 8-kilowatt and two 2-kilowatt series wound negative boosters constructed at Bradford, England, by the Phoenix Dynamo Manufacturing Co., Ltd.

A complete workshop is provided equipped with electrically operated machine tools, and a car shed having a steel roof. It contains six tracks with accommodations for thirty double-deck cars. These cars seat forty-eight passengers, twenty-two inside on longitudinal seats and twenty-six on the top deck on garden seats. There are twenty-six cars



HARFELD'S DESTRUCTOR CELLS AT FULHAM PLANT

twenty-eight feet long and four larger cars thirty-four feet in length, the latter being equipped with two 35-horsepower motors and the former with two 25-horsepower traction motors.

The permanent way has a gauge of 4 feet 8½ inches, with 6.3 miles of double track and 3.7 miles of single track. The sharpest curve has a radius of 42 feet and the steepest grade is 1.16. The rails weigh 95 pounds per yard on straight track and 101 pounds on curved. The rails are laid on a bed of concrete eight inches thick, two inches of concrete being above the sole of the rails and forming a continuous anchorage. At each joint two solid Chicago "Crown" bonds are used, 0000 B and S gauge, each 38 inches long, with cross bonds 60 inches long every 40 yards on single tracks and inter cross bonds at every 80 yards on double track. The bridging bonds are 00 B and S gauge, while all points and crossings are bonded with 0000 bonds at each end and 00 bridging bonds across.

There are seven positive and six negative feeders, varying from one-fourth square inch to one-half square inch in sectional areas. These feeder cables are of the non-metallic sheathed class, insulated with the dialite dielectric, double taped, and braided with heavy jute. These cables are drawn into stoneware conduits laid in tiers of two to twenty-two ducts throughout the various routes and laid in a solid bed of concrete. A three-core pilot cable has been laid along all of the routes for tests and telephone circuits and connected throughout the system to every feeder pillar.

The trolley wire is of hard-drawn copper 000 gauge with a resistance of .235 ohms per 1000 yards and a breaking strain of 5000 pounds, mounted on about 1000 steel poles, weighing from 840 pounds to 1240 pounds. These steel poles constructed at Glasgow by Stuart & Lloyd are made in three sections. The trolley wire is in sections varying from one-third to one-half mile in length and supported by span and pull wires of galvanized steel seven-twelfths gauge.

In the city of Preston the cars are operated on the ten-minute service with an accelerated schedule during the rush hour, and the stopping places are fixed at approximately 160-yard intervals on all routes. The average speed over the system is eight miles per hour, and it is stated that the maximum speed has been fixed by the Board of Trade at twelve miles per hour.

Former Mayor William Margerison, and now alderman of the city of Preston, maintains that the refuse destructor plant of that English city has been operating most successfully and works to great advantage and with great saving to the taxpayer in connection with the Municipal Electric Railway.

PROJECTED ELECTRIC LINE FROM MILAN TO GENOA.

United States Consul J. E. Dunning reports that an electric railroad 85 miles in length and to cost $47,000,000 is to be built between Genoa and Milan, Italy.

The electrical current will be generated by water power by three engines of 24,000 horsepower. To complete the line 19 tunnels will have to be built, the most important being 12 miles long, which will require six years in its construction. The cost of the road will be about $500,000 per mile, according to the estimate. The line will have a double track, the trains being hauled by electric locomotives. The latter will be combined with baggage cars, with two sets of trucks, having four motor axles, each axle of 300 horsepower, and will weigh 45 tons. With this force of 1200 horsepower per locomotive they will be able to operate at a speed of about 54 miles an hour for parts of the line having a grade of eight feet per thousand and at a speed of 80 miles an hour on the level. The trains will be run in three cars, each car carrying 50 persons—the whole train weighing 160 tons. These figures are for the express and local trains. The plan is to have them running from 4 o'clock in the morning till midnight. The express trains will run every two hours. The locals will run much oftener, and will collect passengers from the smaller towns and take them to the express station farther along the line, where passengers can transfer. All locals will, after leaving Milan, take all passengers collected from the smaller stations to the station of Tortona—the only express station—as well as those locals starting from Genoa. The express trains will take passengers from Milan to Genoa, or vice versa, in one and one-half hours, while the locals will require two and one-half hours. In this way there will be 20 trains per day, carrying an average of 6000 persons.

The 70 to 100 freight trains to run each 24 hours will have combination locomotive and baggage cars of the same size and power as those of the passenger trains, and will pull 30 freight cars, each car weighing 22 tons, which includes 12 tons of goods on each car, so that the train will pull in all 700 tons. These trains will run at the speed of 20 miles an hour on the inclines, and about 35 miles an hour on the level.

To prevent accidents, there will be no grade crossings along the line, and 372 bridges must be built. The principal tunnel will be perforated from both ends at once, and at the same time in eight places along the lines, boring holes from above. In all, this tunnel will be constructed from ten borings at the same time. By the time this tunnel is ready the whole line will be finished.

SOURCE OF POWER.

By John Harisberger.*

Realization of profitable commercial and industrial conditions depend very largely on the possibility of obtaining cheap motive power, and the cheapest known power is that derived from natural waterfalls, which is energy coming nearest to being perpetual motion, having any practical value, to be found on this globe.

In the transformation and transmission of this power into such shape that it can be applied to do useful work in localities where work to be done is desired, loss of power occurs. To keep this loss to a minimum is necessary for satisfactory commercial results. This is a problem for the engineer.

Taking for granted that a location has been found where water power can be developed and data as to preliminary work, regarding approximate fall and amount of water available, has been secured, the next step will be to check this data of preliminary work by taking accurate measurements of the flow of water in the stream for several months, desirably during the low-water season. If the elevation of the power site is 2000 feet or over, the supply of water for streams will be derived mostly from glaciers and melting snow, and the low-water season will be in the winter months; while a power site nearer sea-level, the stream being fed by rain, springs, and melting snow in the foothills, the low-water season will be during the summer months. This is especially the case in the Northwest.

While gauging the stream as much information as possible should be obtained from old settlers in the neighborhood regarding flow of the stream in past years, and if the government has been maintaining gauging stations on the stream, records of the United States Geological Surveys will be of considerable value as they are fairly accurate.

The watershed of the stream should be explored to ascertain the nature of the country drained, especially as to forests, and find out if the forests are private property or in the government reserve. Heavy forests on the watershed are of material value from a water-power standpoint, as they tend to regulate the rate of discharge of the stream. Their sponge-like property has the effect of retarding the flow of water to stream, and snow falling during the winter is protected from the sun by the trees, which is the cause of the gradual discharge of the stream instead of a spasmodic flow, as will be the case if the watershed be barren of trees. From this it is evident that it is desirable that forests in basins, at elevation below 3000 feet, drained by streams utilized for power purposes, be in the government reserve, for if they are private property it will only be a question of a short time when the trees will be cut down, thus destroying one of the best and cheapest power storages we have.

By comparing the measurements taken of the stream with information obtained regarding its flow in past years, and making a profile of flow, which would look something like Figure 1, of a stream flowing into Puget Sound, where most of the watershed is below 3000 feet elevation. From this the average flow can easily be determined by the aid of a planimeter. In the past, in fact it is the practice at the present time, to build the power house of no greater capacity than the power of the stream at low-water flow, in which case at least seventy-five per cent of the power available goes to waste by the water flowing to lower level without doing any useful work. Ideal conditions are seldom found as to watershed in its natural state, so that the flow of the stream is uniform the year around, so artificial means must be employed for the storage of the water that the entire flow off of the stream the year around can be utilized. If this can be done, a power house of at least the capacity of average power of stream should be built.

In making an artificial storage basin several things will have to be considered. The most important one is, will it pay? Dams will likely have to be built, land be purchased which will be flooded by the water in basin, and possibly course of stream be changed, which will necessitate securing more water rights. If, by figuring up everything, you find that the cost of storage basin is not more than $20 per horsepower for each horsepower obtainable above power of stream at low-water flow, it is a good commercial proposition.

Surveys must be made to find out exact location of stream where power is to be obtained, so that you will know what land it will be necessary to buy, in order to secure absolute right to use water without the possibility of outside interference.

In securing water rights conditions differ, depending in what localities power is to be developed. The law in this part of the country is that you must not change the natural course of a stream unless it be on your property, and, if diverted, must be brought back to its natural course before it leaves your property. In localities where irrigation laws are in effect, the appropriation doctrine is generally in force, the condition being that if you wish to use water of a stream, you must post a notice on the bank of the stream in the neighborhood where power is to be developed, appropriating the number of cubic second feet, or miner's inches, of water wanted, and file copy of notice with auditor of county where power is to be developed and begin active development work within sixty days. These are the conditions in general. New laws are added and old ones changed as the country is settled.

Having secured absolute water rights, active development work should begin. As stated before, in the transformation and transmission of power, loss of energy occurs. This should be considered at the very beginning of the development work, so as to keep this loss down to a minimum with the least expenditure of money. Having ascertained the amount of average flow of stream, the next step will be to run levels and make surveys to establish a location for power house, where greatest fall can be obtained. This having been done, a location for intake will be decided on, and the lay of the land be examined to ascertain what will be necessary to conduct water to power house under pressure, according to head. If the nature of country is such that the constructing of water conductor from intake to location of power house where greatest head is obtainable will be very expensive, it may be more profitable to decide on a location for power house where cost of water conductor can be kept down very much, but at a loss of a few feet in head. This is a matter of calculation depending upon the amount of revenue that could be obtained from the power available by the few extra feet of fall. If the revenue obtained from the extra feet of head is sufficient to pay interest and depreciation charges on the difference of the cost of the two water conductors and some profit besides, the more expensive one will be decided on. This is one of the many problems that confront the engineer in the development of water power, and if the development is for profit instead of pleasure, the solution in general will be in each case as outlined above.

Location of power house having been established, levels will be taken to determine the exact difference of elevation of head water and location for discharge of tail water. This difference of elevation determines the hydrostatic head and is occasionlly given to water-wheel builders, as the head under which wheels are to operate, and wheels designed accordingly, but when put in operation fail to give efficient results. I will explain the cause in detail in my next lecture on Prime Movers.

Having obtained measurements giving hydrostatic head and flow of water, and knowing what the practical possibilities are for storage of water, the capacity of power house that should be built can easily be determined by the following formula: Horsepower equals .1134 times cubic second

*Lecture to the class in Power Transmission, University of Washington.

feet times head times 71 per cent.

This gives the power at switchboard, allowing for losses in pressure pipe, water wheels and generators, or about seventy-one per cent of the power, which is about as good as can be obtained with apparatus available and average power sites. Many conditions must be considered when establishing location for intake and power house. The possibility of back water interfering with the operation of the water wheels, which may be caused by floods occurring only about once in ten years should not be overlooked.

The shortest possible length of pressure pipe between intake and water wheels for a given head is desirable for good speed regulation with economical use of water, and not have excessive cost of pressure pipe, on account of its large diameter, to keep down velocity of water, satisfactory regulation is impossible when a long pipe line is used for a low head plant, and it is attempted to vary the velocity of the water in the pipe for speed regulation.

In high head plants, where the velocity of the water is kept constant in the pipe, governing being done by diverting part of the water from the runner of the water-wheel, the question of length of pipe line will only be a matter of cost, and convenient locations for intake and power house. The intake for pressure pipes should, if possible, be a storage basin of comparatively large area, so velocity of water will be very low, thus allowing any grit or sand to settle to the bottom. This basin should have a sluice gate, so sediment can be sluiced out occasionally without going down pressure pipes and through water wheels. Sand and grit are very detrimental to the life of water wheel runners, as well as the water wheel housing and pipe line, and every means should be employed to eliminate any sand from the water that is to come in contact with the water wheels. The higher the head the more important this is.

There are several methods of eliminating some of the sand from the water. Having intake for pressure pipes, a storage basin as just described is generally the most practical. If a flume is used, sand traps at intervals in the flume help considerably. If an open ditch is used, settling basins at intervals, of generous size, if possible, so velocity of water will be quite low, give good results, if basins can be drained occasionally to sluice out sediment. Open wooden flumes, especially if built on trestle work, should be avoided, as they are generally more cause of trouble than any other part of the plant. If, for any reason, the flume springs a leak, or becomes choked that water overflows, foundation of trestle will be washed out, if it is not on solid rock. A closed stave flow pipe is more desirable, if it is not necessary to empty pipe often, and leave it empty long enough so it will become very leaky, on account of the wood shrinking. It is a question whether in the long run an iron flow pipe would not be the most profitable. The pressure being very low, it can be made of very light material, and, when properly constructed, is not liable to give trouble, unless a landslide breaks it, when repairs will be more difficult than with a wooden structure. Slush ice is not likely to form in a closed pipe in cold weather as in an open flume, but if flume is of such dimension that velocity is low enough that water will freeze over, trouble with slush ice forming in flume is not likely to occur, in which case a deep and narrow flume is desirable to keep down friction losses. This condition will be the same with earthen ditches. An open ditch is another method of conducting water from stream to intake. If nature of country is suitable, and velocity of water can be kept down low, this is the cheapest and best method. Velocity of water in flumes, seven to eight feet per second, depending on design and construction of flume. Velocity in iron flow pipe about the same. In earthen ditches velocity should not be over three feet per second, preferably less.

In developing water power there is rarely ever a case where it is not necessary to build a dam, generally several. If the velocity of stream is high at the location where dam is to be built it is most likely the river bed and banks are of rock formation, in which case a concrete dam would be the proper construction, as a very substantial structure could be built on account of being able to get good anchorage, which would not be the case if the river bed and banks are soft earth and a long distance to bedrock, when a dam of rock-filled crib work construction would be better. Earthern fill dams are sometimes used.

CONCRETE TELEGRAPH POLES.

The Pittsburg, Fort Wayne and Chicago Division of the Pennsylvania Railroad is experimenting with concrete poles for their telegraph service. In the Fall of 1906 they erected a mile of these poles on their right of way near Maples, Indiana, in order to test them out in actual service

They were built by Mr. Herman Tapp, contractor of Fort Wayne, at Maples, Indiana, and were hauled out on cars to the point of erection. The profile of the ground being somewhat uneven, the lengths of the poles were varied from twenty-five to thirty-four feet, in order to keep the tops of the poles as nearly as possible on a continuous grade. The poles were 8 inches square at the bottom, and were tapered to a 6-inch square at the top, the corners being chamfered two inches, making the pole appear octagonal above the ground.

Holes were left for the brace and cross-arm bolts and also for the steps. The reinforcement consisted of twenty-four ¼-inch wires running the full length of the pole. The conditions under which the poles were erected were not of the best, as the work was rushed in order to have the pole line complete for the date of a certain inspection trip. Because of this fact some of the poles were moved from the point of building and were erected within five days after they had been made. Nothwithstanding this hurried method of construction and the severity of the windstorms of the past winter, the poles show up at present in almost perfect condition. The alignment is of the best, and the condition of the individual poles is very good, as no check marks or other signs of failure have appeared. The poles were set four feet under the ground and were bedded in stone screenings giving a solid foundation. Although the time these poles have been in use is not sufficient to warrant any sweeping statements as to their value, yet it is a fact that the first eight months of service have certainly showed exceptional results in favor of the use of concrete for this purpose. These can probably be put in at a cost of $8.00 per pole.

INDUCED DRAFT IN THE BOILER HOUSE.

In a paper by an English author on "Notes on the Application of Induced Draft," reference was made to one case in particular of five boilers fitted with steam jets, which resulted in a coal consumption of 27.3 pounds of coal per square foot of grate, the evaporation from and at 212 degrees being 9.8 pounds of water per pound of coal, with a temperature of the economizer water of 166 degrees. With induced draft the results obtained were as follows: Coal consumption per square foot of grate, 25.4 pounds, evaporation of water, 10.2 pounds per pound of coal; and temperature of economizer water, 259 degrees. Taking measurements of the electrical output of the plant, it was found that, using the steam jets, for each unit of electricity 3.6 pounds of coal and 30 pounds of water were consumed. With induced draft the results were 3.1 pounds of coal and 28 pounds of water per unit of current. In this case 1800 gallons of water were simply evaporated for use by the steam jets. The net saving in this case worked out at 14½ per cent.

THE ELECTRICAL DRIVING OF WOODWORKING MACHINES.

By E. L. Nichols.

It is certain that no one not actively engaged in the building of electrical machinery appreciates the extent to which the motor drive is being employed in all lines of mechanical and engineering work. The modern electric motor with its superior economy, reliability, and flexibility of application fits into almost every conceivable situation, so that the rapidly increasing proportion of manufacturers of special machinery have acceded to the popular demand and are now either supplying their appliances with motors attached, or so constructed that motor drive can be readily applied.

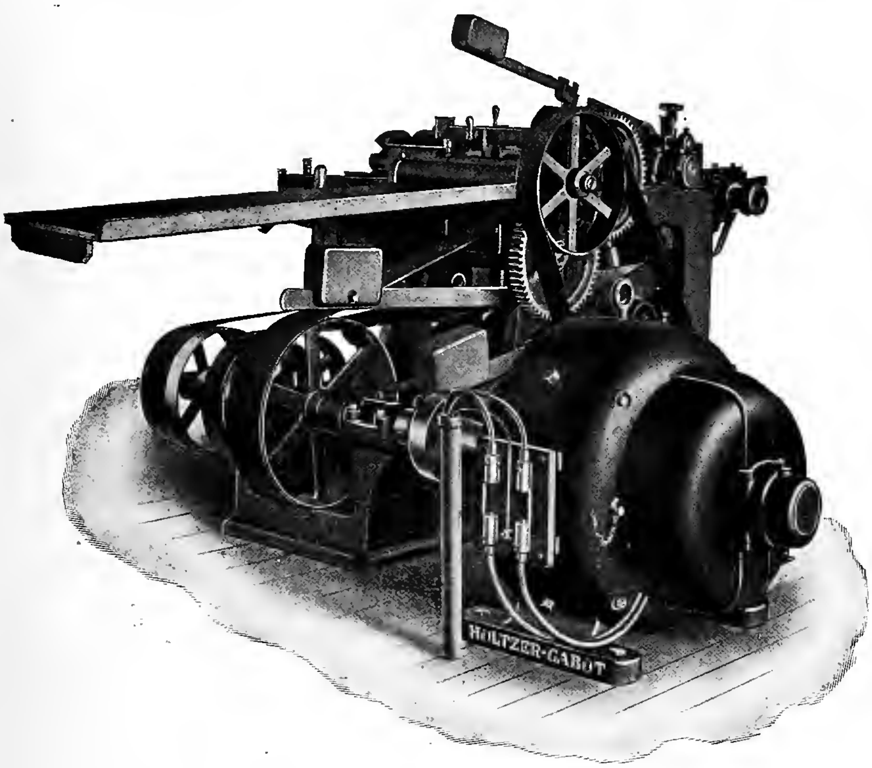


FIG. 1. OUTSIDE MOULDER DIRECT CONNECTED TO ELECTRIC OTOR

Each day produces new evidence that the electric motor is growing in popularity as a means of driving wood working machines. Some of the best plants built this year are provided with individual motor drive, and a number of others now in contemplation will make use of electric power. It is getting to be quite a common thing to read, in connection with the equipping of a new wood working plant, that electric motors are to be used for driving the machines. Of course some new plants put in engines, and use shafting and pulleys just as has been done for generations, but a sufficient number of the new ones are putting in electric drives to make the matter highly interesting. Their experience will be watched by a growing number of other mill and factory owners who would like very much to adopt the electric drive but have the same feeling about it that people usually have toward a new method which displaces one that is time honored and well understood.

A great deal might be stated in favor of electrical driven equipments and especially where the individual drive is adopted, but some of the most important advantages together with illustrations of a few typical installations will suffice for this article.

The item of wear and general depreciation of overhead shafting and pulleys is one which cannot be lost sight of and is one which tends to increase rather than decrease from year to year. A large nvmber of accidents, some of which are fatal, result annually from long lines of shafting and pulleys. With the individual electric drive there is no shafting nor belting to speak of, for the motor is direct connected by coupling or short belt (for speed reduction) to the machine in question. The only wear, then, is on the motor and the machine, both of which are so constructed as to last a goodly number of years without undue repairs.

Another point in favor of the electric motor is the alacrity with which it responds to any given piece of work. The switch is thrown and it starts immediately upon the first notch of the controller. There is no fear of overloading the shop by running all the machines at once for each is separately driven and the motors are built to withstand a large per cent of overload without undue heating or sparking.

Then a point which has already been touched upon, is the cost of operating an entire plant for the use of one or two machines. It frequently happens that "Rush" orders necessitate a part of the plant working nights or holidays, in which case all the shafting is run to operate two or three machines which are liable to be located in a remote portion of the shop furthest from the engine room or water wheel. This is no small matter and many times overtime is dispensed with on account of the excessive operating expense, even to the result of losing some business. The individual electric drive makes it possible to operate each machine as cheaply at night and on holidays as during regular running hours, for only as many motors are consuming current as there are machines running, and as a rule power costs no more at night than in the day time. A large saving in operating expense is brought about in this way as may be readily seen.

Furthermore with the electric drive, there are no operating expenses except for such time as the machines are actually in operation. There is no necessity to "fire up" before dawn and start the engine several minutes before opening time, for electric power is always ready, and it is shut off with equal ease

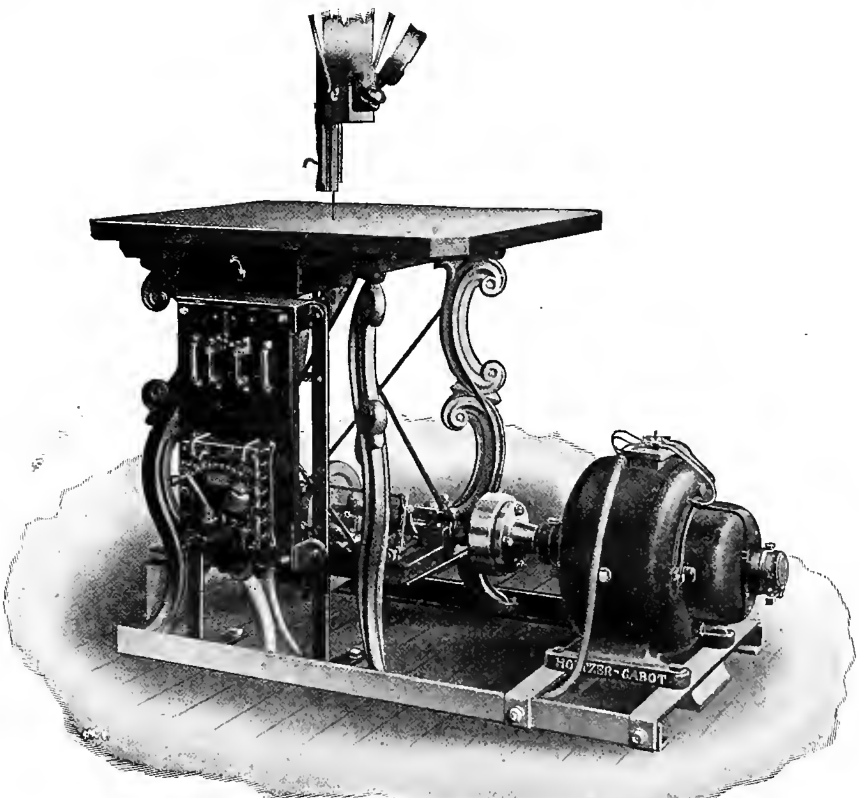


FIG. 2. EUREKA JIG SAW DRIVEN BY ELECTRIC MOTOR

and dispatch at closing time. This saving will be instantly appreciated.

Not only are cumbersome shaftings and belting a menace

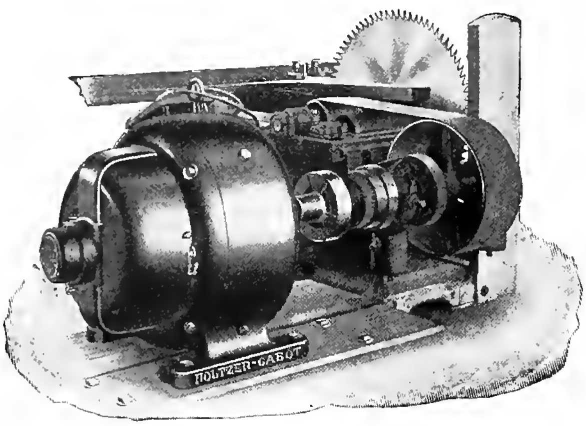


FIG. 3. RAILWAY CUT-OFF SAW DIRECT CONNECTED BY COUPLING TO ELECTRIC MOTOR

to life and limb in a wood-working establishment, but from an aesthetic point of view are equally as bad. They make the rooms darker and tend to keep the dust in motion, instead of allowing it to settle, thus making the atmosphere far from healthy for the employees. The enclosed type of motor does not stir up the air, and is practically dust and moisture proof, which increases its efficiency, and is conducive to cleanliness and good health.

Throughout a plant of large size the loss of power due to shafting friction and belt slipping, is greater than is generally imagined, and when this is entirely eliminated by installing the individual electric drive, the saving will be sufficient to pay for a large part of the expense of making the change.

It is admitted that the first cost of electric motors, especially one for each machine, means quite a little delay, but when taken into consideration with the saving which will result annually as long as the plant is in operation, the balance is in favor of the operators of the establishment.

It may be also stated here that it is possible to make the change to electric power without interfering to any extent with the operation of the plant, as the motors may be installed during working hours and the final connections made quickly after closing time. Thus, one by one, the machines are changed over until finally the shafting and belting may be relegated to the archives of the past.

Electricity is the power of the present and future for some time to come, and stands a peer for economy, cleanliness, flexibility and efficiency.

The accompanying five illustrations show dust-proof motors manufactured by The Holtzer-Cabot Electric Company, Brookline, Mass., direct-connected to a variety of wood-working machines. These outfits are installed at several navy yards, and demonstrate the latest engineering practice in this sort of work.

Figure No. 1 shows the above type of motor direct-connected by couplings to a Woods Machine Company's No. 129 Outside Moulder. Figure No. 2 shows a similar type of motor direct-connected to a Eureka Jig Saw. The entire absence of belts in this cut will be noted, and also the switch and controlling rheostat are located where they are readily accessible to the workman.

Figure No. 3 shows a motor of this description direct-connected by coupling to a 40-inch railway cut-off saw, and Figure No. 4 shows the direct-connection of a motor and Atlantic Works' No. 4-B, 44-inch band re-saw. The illus-

FIG. 4. DIRECT CONNECTION OF MOTOR AND BAND RE-SAW

tration in Figure No. 5 shows a dust-proof type of motor direct-connected to counter shaft of S. A. Woods Machine Company's No. 173 Double Circular Saw. The belts shown in some of the illustrations form a part of the machine giving different speeds to different parts of the machine.

The services of the motor engineering department of The Holtzer-Cabot Electric Company are at the disposal of all parties who may be interested, and information in this direction will be gladly given upon request.

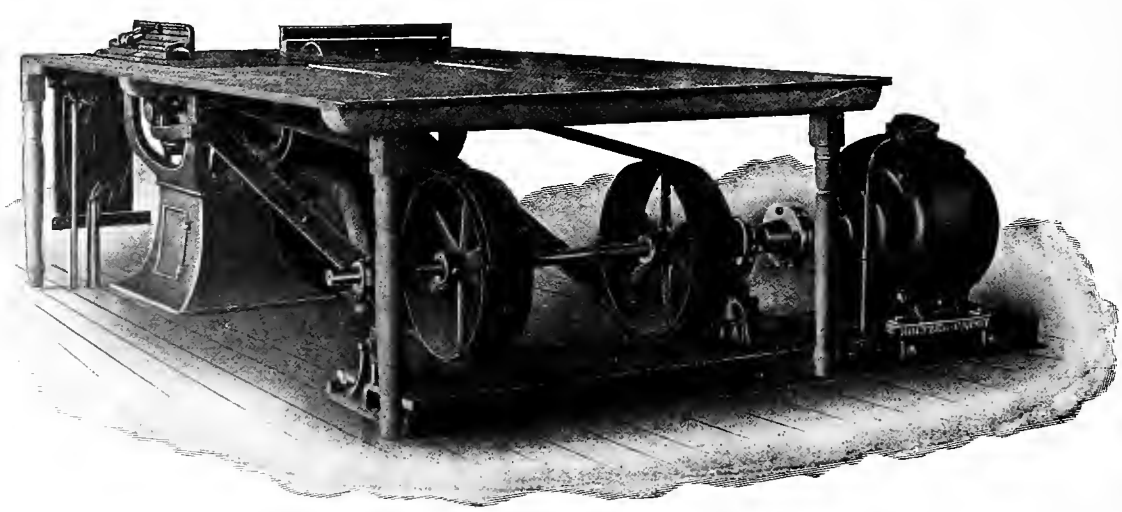


FIG. 5. DUST PROOF MOTOR DIRECT CONNECTED TO DOUBLE CIRCULAR SAW

PROTECTION FROM FIRE.

Fire has always been the worst enemy of the forest. In many cases the risk of fire is so great after lumbering that landowners have not tried any system of conservative logging, but have instead cut the forest clean in the belief that young timber would be burned, if left, before it could attain sufficient growth for a second crop. This is almost the rule in the heavy forests of the Pacific Coast, where fires have been so prevalent that they have come to be regarded as a necessary evil. A single fire among young trees may not always kill them, but it will check their growth and weaken them so that they will be very susceptible to insect attacks and fungous diseases. Recurring fires, however, at last destroy the whole forest stand, and then chaparral takes possession. On cut-over lands there is usually a great accumulation of debris, and this encourages fire, so that one of the first steps in fire protection is some provision for the removal of debris.

In 1904 the Forest Service in co-operation with the State of California made a thorough study of forest conditions and their relation to fire on the tract of the McCloud River Lumber Company, in Siskiyou County, Cal. The chief object of this study was to devise some practical system of forest protection. The results, which are now published in Circular 79 of the Forest Service, show (1) that by proper care and the execution of certain measures it is possible to decrease, or even to eliminate, the danger from forest fires; (2) that such protective measures may be carried out at a reasonable cost; and (3) that the results in most cases will fully justify the necessary expenditures.

The plan adopted, which aims to prevent fires from starting by means of patrol along carefully laid-out routes, was executed so successfully that it has since been extended to all the holdings of the company. Telephone and tool stations have been established, and broad fire lines on which the slash was burned have been run through the cut-over land. The cost of all this was about 2 cents per acre per annum.

The details of this plan, accompanied by a description of the tract and the forest types, and an estimate of the future yield and value of cut-over lands protected from fire, are given in the circular, which is entitled "The Control of Forest Fires at McCloud, California." This publication will be sent free upon application to the Forester, United States Department of Agriculture, Washington, D. C.

LARGEST GASOLINE PASSENGER LAUNCH IN THE WORLD.

(Staff Correspondence.)

One of the most interesting achievements in the maritime world is the erection and completion on this Coast of the largest gasoline passenger launch in the world. The boat has been in steady service since the first of January between San Pedro Harbor and San Diego, making two round trips a week with two additional trips to Avalon and Coronado Islands, giving perfect satisfaction. The engines have never stopped for repairs or adjustment since the first alignment. The craft is 140 feet long, 22 feet beam, with a draft of 10 feet. It is allowed 256 gross tons and will carry 260 passengers comfortably, with an average speed of about fourteen knots. There are two 6-cylinder engines, each of 300 horsepower, making a total of 600 horsepower. The boat is driven by a twin screw. It also carries a 16-horsepower, 4-cylinder, direct connected lighting engine, which supplies light and heat to the craft, and also a 12-horsepower fire pump engine.

The engines were designed and built by Mr. G. F. Stephenson of 1263 Bellevue Avenue, Los Angeles, Cal., now with the S. J. Smith Machinery Company of that city.

THE WATER POWERS OF PERU.*

The present developments of the southern Peruvian water power, reports Mr. Guarini, professor of physical and electrical science at the "Escuela de Artes y Oficios" of Lima, Peru, are insignificant, being limited to a 1000-horsepower installation furnishing light and power to Arequipa, and a very modest private lighting plant in the Tambo Valley.

At Mollendo there is today no power plant of any description. The Peruvian Corporation is about to install a steam plant to furnish power for industrial purposes and harbor work during the day, and for public lighting at night. The high cost of fuel and the uninterrupted demand for power during the twenty-four hours, however, make the advantages of a water-power installation apparent.

In the immediate vicinity of Mollendo, in the Tambo Valley, there are a number of small streams capable of developing several hundred horsepower, which can be easily utilized and transmitted electrically. The supply of power available from this source is so much greater than any demand in sight for it at Mollendo, that a primitive wooden water-wheel of local manufacture, in connection with a dynamo and a few kilometers of copper wire, would amply suffice for present requirements and would represent a great saving in first cost and in operating expense over the proposed steam plant. The utilization of the city's water supply to operate a wheel before entering the distributing mains suggests an alternative source of power.

Mollendo gets its water from the mountains at an elevation of 2300 meters above sea-level, whence it is conveyed a distance of 140 kilometers through pipes, 20 centimeters in diameter at a velocity of 20 litres per second, according to Chief Engineer Bustamante y Raneda, in his recent report and project for increasing the water supply of Mollendo. Friction losses would average five millimeters per meter of pipe, or 700 meters for the entire distance, not including loss of head from short turns, bend and angles.

On the basis of 1 horsepower equals 175 kilogramme meters, net available, and allowing 75 per cent as the efficiency of the wheel, the theoretical available power would be 320 horse.

In practice, however, writes Professor Guarini, this result could not be obtained for two reasons: First, because the present pipe line could not resist the attendant pressure of 219 atmospheres, and, second, because the entire theoretical head is not available, owing to the fact that the line is sectioned off in several separate reservoirs at different levels, serving to supply intermediate towns and villages, and also to relieve the pressure on the line.

The power problem would consequently have to be solved by either of the following methods:

1st. By installing a water-wheel and alternating generator set at the mouth of each reservoir, feeding a single cable carrying the current to Mollendo and furnishing power to different localities on the way. Under existing conditions, at least 250 horsepower could be delivered in this manner at Mollendo during 24 hours, supplying 3000 standard 16-candle-power lamps, equaling 48,000 candle power, or 3000 special filament 32-candle-power lamps, equaling 96,000 candle power.

This output could be further increased, adds Mr. Guarini, by installing a storage battery at Mollendo, which could be charged during the daytime.

2d. By building two reservoirs at Mollendo at different levels, the lower one to be used as the supply reservoir proper for distribution, and the other as a water-power storage basin, which would empty into the lower reservoir during lighting hours.

Under present conditions, each reservoir would have a capacity of 900 cubic meters (that being the capacity of the existing basin) and a difference of mean level of 220 meters

*Abstract from the "Engineering Magazine."

(that being the actual difference between the Mollendo reservoir and the last section basin). This would give a flow of 10 litres per second for 24 hours, or 40 litres per second for 6 hours, or an equivalent of 88 actual horsepower, sufficient to supply 1000 special 32-candle-power incandescent lamps for 6 hours, which would be fully adequate for the immediate needs of the little town of Mollendo.

According to Mr. Guarini, the Tambo Valley abounds in small water-powers, which could be easily developed to supply power to run the machinery in the sugar mills that dot the valley, during the day, and to light the many estates and farms at night.

Today the only application of these natural forces is to be found on Mr. Lira's plantation, where a miniature electric-lighting plant is run by a very primitive and inadequate water-wheel of native design.

At Arequipa the "Sociedad Electrica de Arequipa" owns and operates a hydro-electrical central station at a place called Charcani, about eleven kilometers from the town, the motive power for which is supplied by the Chile River, with a maximum capacity of 1000 horsepower. Current will be delivered at Arequipa over a three-phase line of 5400 volts, for power and lighting purposes, as soon as the installation is completed.

The intake flume, about 1300 meters long, has a capacity of 4 cubic meters per second. With an available head of 26.5 meters it is possible to develop a theoretical force of 1413.33 horsepower and an actual output at the water-wheel shaft of about 1060 horsepower. The original equipment consists of two turbines consuming 865 litres of water per second, and developing 248 horsepower each, or a total of 496 horsepower. Each wheel operates a single-phase, alternating-current, 50-cycle, 5400-volt generator.

The high-tension current is carried over an eight-wire line into Arequipa, a distance of 12,500 meters, where it is converted to 110 volts at a sub-station, through sixteen static transformers of capacities varying between 2 and 20 kilowatts.

Mr. Guarini says that Arequipa today uses ten 1000-candle-power arc lamps and 4391 incandescent lamps of different ratings, aggregating 77,972 candle-power. The lighting service is, however, most unsatisfactory, owing to the insufficiency of the present equipment to meet requirements. As a result, the streets are half the time in the dark, and complaints from private subscribers are constant—the company being unable to supply the current contracted for and give satisfactory service, on the one hand, and the consumer trying to get even with the company, on the other, by using lamps on their circuits of double the rating that they are entitled to, in an effort to get a modicum of brilliancy.

The Sociedad Electrica de Arequipa, it must be admitted, is now installing an additional 500-horsepower equipment, which should suffice for present requirements, although, as a matter of fact, an entirely new hydro-electric plant would be advisable in order to bring the light and power service up to the standard expected in a first-class city of the importance of Arequipa.

Another source of supply, Professor Guarini writes, should be the Chile River, which is amply capable of furnishing all the motive power necessary for the purpose, representing, as it does, a colossal hydraulic force hitherto overlooked.

Mr. Habich, director of the Technical School of Lima, in an article published in the Bulletin of the Mines of Peru, in its issue of July 31, 1901, pointed out that Peru, with its rivers descending from elevations of 3000, 4000 and 5000 meters, possessed incalculable sources of power and showed that the Rimac River alone was capable of developing at least 100,000 horsepower.

Returning to the River Chile itself and basing calculations from a point a little above the location of the present station at Charcani, about 3000 meters above sea-level, Mr. Guarini estimates that this stream carries a volume of water of six cubic meters per second, equal to a theoretical force of 240,000 horsepower. By properly damming the Chile between Charcani and sea-level it would be easy to develop a minimum effective power of 100,000 to 120,000 horsepower.

The objection to such a scheme would be the fact that the water thus taken from the stream could only be used for irrigation after passing through the water-wheels, which, if installed at sea-level, would render such utilization impossible, whereas the Peruvian government is unequivocally opposed to the granting of any water rights whatever that would interfere with its plans for increased irrigation facilities. In the eastern part of Peru there is such an abundance of water that this restriction does not obtain, but on the seaboard it is necessary either to utilize the higher levels of the streams (up in the mountains), or to have recourse to partial and successive developments so as not to interfere with irrigation. For the specific case of Arequipa the latter plan is the most practical.

Professor Guarini proposes the following solution: By lowering the location of the present plant about 400 meters, it would be a simple matter to increase the head from the 26 meters now available to at least 100 meters. This would in no wise prejudice irrigation, as there are no lands whatever under cultivation between the present and the proposed locations of the plant.

By lengthening the present flume or ditch, a force of 4000 horsepower could be developed, while by building a new flume of sufficient capacity to carry the six cubic meters of which the Chile River disposes, a force of 6000 horsepower could be obtained.

With such a supply of electrical energy available the electrification of the railroads of Southern Peru would follow in due course, either totally or partially, creating a large market for power.

The Peruvian Southern Railroad operates 359 kilometers of road over an average grade of 1.3 per cent, between Mollendo, which is at sea-level, and Crucero Alto, the highest point on the line, at an altitude of 4.840 meters.

The next and by far the most important source of water-power supply of Peru, points out the hardy pioneer, is Lake Titicaca, lying 3800 meters above the level of the sea, with a surface area of 6600 square kilometers and an average depth of 20 meters.

Lake Titicaca is an isolated basin into which a great number of rivers empty. The outlet of this basin is the River Desaguadero, which discharges its waters into Pampa Aullagas, where they are lost through evaporation and filtration. There is a popular belief that a subterranean stream continues and discharges into the sea, but scientific investigations have failed to substantiate the theory and it appears certain that this water is absorbed only by evaporation and filtration. The fact remains, however, that the Desaguadero River before entering the Pampa Aullagas carries a volume of 100 cubic meters of water per second, whereas the stream that serves as outlet to this lake has a volume of only one cubic meter per second.

For various reasons, and especially for the purpose of utilizing this water for irrigation after leaving the turbines, it is desirable to have this water fall over the Pacific Slope. Lake Titicaca lies in a hollow, surrounded on all sides by an unbroken ridge of mountains, ranging from 250 to 800 meters in height, presenting a formidable engineering problem which can be overcome by only two solutions: either tunnelling through the mountain, or pumping the water up and over the lowest practicable eminence.

The distance from Lake Titicaca to the Pacific Ocean, as the crow flies, is 250 kilometers.

According to surveys, the shortest practicable tunnel that could be bored through this natural barrier to the nearest valley would be between thirty-five and forty miles long. This, while entailing an enormous cost, would greatly shorten the transmission line.

As regards the alternative plan of pumping the water

over the side of the mountains, it should be called to mind that the highest point on the ridge immediately encircling the lake is Crucero Alto, at an elevation of 4600 meters, or about 800 meters above the level of the lake. In the event of an actual undertaking of such an enterprise, a much lower point would, of course, be determined upon after proper surveys; but for the purpose of demonstrating its feasibility, Crucero Alto will be selected, indicates Professor Guarini, as the peak to which the water must be raised, and, furthermore, the pipe line will be assumed to follow the tracks of the Peruvian Southern Railroad (a very much longer and more circuitous route than would be taken in practice), a total distance of 524 kilometers.

To raise 100 cubic meters of water one meter in one second requires 1900 horsepower with good pumps. The difference in levels between the surface of the lake and Crucero Alto being 800 meters, a force of 1900 times 800, equals 1,520,000 horsepower would be necessary.

At first sight this figure appears appalling, but it will be shown hereafter that the available supply of power for the pumping station would be far in excess of this amount.

One hundred cubic meters of water under a head of 4600 meters represent a theoretical force of 6,133,333 horsepower, which, after deducting 1,520,000 horsepower consumed at the pumping station, would still leave a theoretical supply of 4,613,333 horsepower to dispose of.

Assuming the penstock to be built of a number of pipes, each one meter in diameter and carrying a volume of 628.3 litres of water at a velocity of 0.8 meters per second, loss of head may be estimated at one meter per kilometer, or 524 meters for the entire line, equal to 698,666 horsepower to be deducted.

Further, allowing 1,914,667 horsepower for losses from all sources, in the turbines, generators, etc. (which is extremely liberal), a net surplus of 2,000,000 horsepower of electrical energy would be left available for sale.

The plan above which has been, as aforesaid, suggested by Mr. Guarini, provides for the driving of the pumps by the electrical energy generated by their own initial action, but it must, of course, be understood that steam is contemplated as the original motive power at the pumping station. For example, a pumping station would first have to be installed on the edge of Lake Titicaca, at a suitable point such as Puno, driven by steam, with a capacity sufficient to force one cubic meter per second to a height of 800 meters. Such a pump would consume 1520 horsepower to perform the work.

This water would be pumped into a reservoir at Crucero Alto, from which it would fall by gravity to sea-level, where it would develop, as above shown, an actual net force of 35,000 horsepower of electrical energy, or more than double the power required to drive the pump at Titicaca. After supplying this power to the first pump, there would be a reserve force of 20,000 horsepower left, which could be used to drive a second pump, and so on successively until, with adequate capacity in the Crucero-Alto reservoir, one hundred pumps could be kept in automatic operation, delivering a net total of 35,000 minus 15,000 times 100, equaling 2,000,000 horsepower, as above demonstrated.

The market for this supply of power would be in its application to the electrification of present steam roads and the operation of new electric properties, mining and agricultural industries, public and private lighting, the manufacture of carbide of calcium at the coal mines, the operation of overhead conveying cables, which are in general use in Peru, and for heating, household and general power purposes.

A petition is now before Congress urging the appointment of a special commission to make surveys and reports on the feasibility of such a development and to prepare estimates on the probable cost of construction, with a view of drawing up a bill of conditions governing a concession under which foreign capital will be invited to undertake the project.

NITRATES FROM THE AIR.

The world's supply of natural nitrate comes from Chile and is being so rapidly exhausted that thirty years' time will likely see the end of it. Nitrogen constitutes the most important of the three fundamental elements of plant food, the other two being potassium and the phosphates, so that without nitrogen for plant food vegetation would starve when the supply becomes exhausted, and the failure of vegetation would mean starvation throughout the animal kingdom.

Recognizing this situation to which the world was drawing near, Professor Frank and Doctor Caro, scientists of Germany, set about to find a method of deriving nitrogen artificially from the air itself, as the atmosphere is an inexhaustible reservoir of that element, and binding it in a compound to serve as a vehicle by which it could be handled practically and of such a nature as well as would be slowly soluble and capable of assimilation by plant life after being placed in the soil. This same Professor Frank was also the inventor and founder of the present industry for making potassium fertilizers which has done so much for agriculture. For sixteen years they have given their best labor and abilities to this most important problem and have during the last six months perfected it as a commercial process, and patents protecting its use and manufacture have been secured from all the civilized nations, the rights to which patents have been parcelled out to different interests in the several nations.

The rights for America have been taken over by two American engineers, Mr. Frank S. Washburn and Mr. Charles H. Baker, of 100 Broadway, New York.

The final product which the process obtains is composed of limestone, coal and nitrogen, and is popularly called "lime nitrogen," twenty per cent of the weight of which is nitrogen. The chemical name of the compound is calcium cyanamid. This compound not only has its direct use as an agricultural fertilizer, but it will be most extensively used in the chemical arts for the production of ammonia, nitric acid, and other useful things. As a measure of the magnitude of the consumption of Chilian nitrate it might be mentioned that the United States alone imported last year 375,000 tons of it, having a value of $20,000,000. A column of the atmosphere resting on any two acres of the earth's surface contains the same amount of nitrogen as did last year's importation from Chile.

The new fertilizer—lime nitrogen—costs less to make than Chilian nitrate is sold for, so that the worn-out farms of any poor farmer will be within reach of its restorative and fertilizing properties. Two crops in Europe have already proved its great value where the nitrogenous elements have been lacking, and it is thus known that such crops as wheat, tobacco, cotton, sugar cane, and truck gardening are greatly increased by its use. The original lime nitrogen factory in Italy, which runs night and day, is already so much overtaxed that its capacity is now being more than doubled.

The Agricultural Department at Washington is taking a great interest in the new fertilizer and is having it investigated by the department experts. Great factories for its manufacture are now in process of construction in several of the nations in Europe and one of them which is under way in Germany will involve the construction of a 75,000 horsepower water-power plant. The parent company is the Societa Generale per la Cienamide of Rome, Italy, which is controlled by the Deutsche Bank of Berlin, Germany, and the Siemens & Halske Company, also of Berlin, the largest electric manufacturing company in Europe, which companies financed the very costly experiments and researches conducted by Messrs. Frank and Caro during the long period of experimentation leading up to their great invention. The same German int rests will have a considerable financial interest in the American company.

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EDITORIAL.

THE PRINCIPLE OF THE "OPEN SHOP."

San Francisco has been Union-ridden so long that the opinion is strongly prevalent that her doors are closed to the principle and practice of the "Open Shop." When the logical and natural argument in favor of industrial freedom, exemplified in the text of the "Open Shop," is advanced the average San Franciscan, employer or employee, shakes his head, as much as to say that this city is forever committed to the industrial, if not political, domination of Trade Unionism. Is this diffidence well founded?

Certainly, if we must measure the temper of this community by the fearsome attitude of many of our merchants and other employers, it would seem that this fundamental principle of American institutions, guaranteed by the law and the constitutions of both State and Federal Government, has lain so long dormant that its disuse is mistaken for its destruction. On all sides we hear men, both employers and employed, protesting against the despotism of Union leaders, their irritating regulations, their apparent determination to have even more to say about the conduct of any business or any industry than those responsible for their foundation and financing. But the protest is generally rather the lamentation of those who like "any old fish can swim down stream." Something more than protest is needed for a live fish to swim up stream.

It is the painful experience of those who for years, believing in the basic principles of Labor Unionism, have preferred to deal with an organized body than with individuals in their employ, that the walking delegates and agitators remain satisfied no longer than Irish politicians. You give them an inch; they want an ell. Their conditions are frequently as intolerably restrictive upon the employed as upon the employer.

The basic principles of Labor Unionism have come, here as elsewhere, to stay. The man who thinks that Labor Unionism can be "downed" and Labor Unions dissolved, and proceeds along such a course, might as well ram his head against a brick wall. As "The Journal" pointed out last week, the evolution of Trade Unionism has generated abuses, as well as uses. It is these abuses that sometimes make employers "fighting mad." But the employer who talks of "fighting Labor Unions to a finish," and imagines that it is to the permanent, vital interest of capitalists to array themselves against Labor Unions, is a false and foolish prophet. Such tactics are absolutely futile, and are calculated to aggravate the social disorders and the quarrels between the employed and the employers, rather than to diminish or eliminate them. The axiom that Labor and Capital are inter-dependent forces apparently needs constant inculcation. They are natural allies, and the man who makes them artificial enemies is pulling down, instead of building up.

Whatever strength Trade Unionism may obtain in any community, even though the majority of a community are either members of Unions or sympathize with them; however powerful their organization may be, not only industrially but politically, nevertheless, the sacred right of the individual, employer or employed, to buy or sell labor as seems best to the individual must be acknowledged. For such individual liberty is a fundamental principle of the Constitution of the Republic of the United States. Both State and Federal Constitutions ordain the principle of industrial freedom; the law and its officers are supposed to protect, and, if need be, to enforce that principle.

When one comes to contemplate calmly the tremendous opposition and antipathy to the very idea of the "Open Shop," the fair-minded man is amazed. For instance, we read in a daily newspaper, especially the mouth-piece of local Unions, that "the 'Open Shop' in San Francisco is an impossibility," and that, "Surely Mr. Calhoun does not wish to be the instrument by which San Francisco is to be offered as a vicarious sacrifice on the altar of the 'Open Shop.' "

"It would not be pleasant for Mr. Calhoun," con-

tinues this organ, "to be responsible for the commercial ruin of this city. * * * It surely cannot be for the benefit of Union Labor men that San Francisco should be selected as the battle-ground on which the bitter battle of the 'Open Shop' is to be fought."

Mr. Calhoun is a builder, not a destroyer. His company is responsible for the greatest single investment in San Francisco. His company is the heaviest taxpayer in San Francisco. Last year alone the United Railroads spent six million dollars in the improvement of its system. In fighting for the principle of the "Open Shop" Mr. Calhoun sees no "commercial ruin" in sight; on the contrary, he foresees that the peace and prosperity of San Francisco depend on the establishment of the principle of the "Open Shop." In his address before the Conciliation Committee of the Civic League the president of the United Railroads convinced his auditors of the undenied and inviolable justice and fairness of the principle of the "Open Shop." Mr. Calhoun said: "It is of the utmost importance to the present and future prosperity of this community that the whole country shall be made to understand that men will be permitted to work in lawful occupations in this city, free from the dictation or the interference of any organized body of men. This right is fundamental. * * * Without its full protection there can be no individual liberty, either of employer or employee."

Again Mr. Calhoun plainly laid down the issues which to-day must be faced: "Shall men be permitted to work without threats of coercion and without bodily harm?" In conclusion he hoped "that the Union Labor of this city will aid the United Railroads in demonstrating to the country that life and liberty will be secure in San Francisco, and that men will be permitted to work, whether they belong to a Union or not."

In a recent issue, "The Argonaut" said: "Whether or not we are to have in San Francisco a return to American standards in industry—to the 'Open Shop'—is as yet undetermined. The reason is that both in industry and business we have so large a jelly-fish element that concert of action is slow to be attained. * * * The 'Open-Shop' principle is the one enforcement that would save San Francisco and immediately restore her prosperity. * * * Not until we can hang out the sign of the 'Open Shop' can we hope for such restoration of self-respect and of outside respect as our need calls for."

There are thousands of strong men, and true, in this community. There are thousands who will fight to the last ditch, not against the principles of Labor Unionism, but against the damnable heresy that would lower American standards and undermine the sacred principle of individaul liberty for which our fathers fought. It is quite possible for labor unionists and non-unionists to live, work and thrive in the same community. The rules of the Unions prevent them from working side by side, and there is some logic in such prohibition on the part of the unionists. But the tactics of intimidation and assault which have been all too prevalent in San Francisco during the last few years must forever be fought and frustrated if this city is to regain its own prestige, to restore general confidence, and to realize its splendid destiny.

It is a blasphemy to say that any California city cannot maintain American principles. It is as criminal as it is foolish to cry that the "Open Shop" in San Francisco is an impossibility. The men who are determined to establish industrial freedom in San Francisco need neither pity nor warning. They have counted the cost and are prepared to meet it. None but a traitor can pretend that American principles will not eventually triumph in a noble, libery-loving American city.

TRADE CATALOGUES.

Bulletin No. 30 from the Warren Electric Mfg. Co., Sandusky, Ohio, illustrates and describes the revolving field Warren alternators.

The Rockwell Engineering Company, 26 Cortlandt Street, New York, send two bulletins illustrating the use of oil or fuel gas furnaces for rod and bolt heating.

Bulletin No. 76 from the Wagner Electric Mfg. Co., of St. Louis, gains some interesting information on single-phase variable-speed, ventilating fans as manufactured by this company.

The Westinghouse Companies' publishing department send a handsome brochure of Westinghouse views, including a few views of Washington. This was prepared for the thirtieth annual convention of the National Electric Light Association and is an unusually fine example of half-tone work.

PERSONAL

H. C. Thaxter, manager of the Standard Electrical Works, is in Seattle.

C. R. Weymouth, engineer for Chas. C. Moore Company, has returned to San Francisco from New York.

Roger Chickering, manager of the Wonder Light & Power Company, Wonder, Nevada, is in San Francisco.

Mr. A. A. Peters, southwestern manager of the National Meter Company, with offices in Los Angeles, is in San Francisco.

LOCAL STOCKS AND BONDS

Furnished by Courtesy San Francisco Stock and Bond Exchange.

Outstanding	INTEREST	MISCELLANEOUS BONDS.	JUNE 7		JUNE 8		JUNE 10		JUNE 11		JUNE 12		JUNE 13	
			Bid	Asked	Bid	Asked	Bid	Asked	Bid	Asked	Bid	Asked	Bid	Asked
1,532,000	F & A	Associated Oil Co. 5%	80	82	80	82	80		80		80			
2,250,000	M & S	Bay Counties Power Co. 5%		100		100		100		100		100		100
1,000,000	F & A	Cal. Central Gas & El. 5%		103		103		104		104		104		103
9,600,000	M & S	Cal. Gas & El. Gen. M. & C. T. 5%		79	76	79		79		80		79		79
900,000	J & J	California St. Cable Co. 5%	100		100		100		100		100		100	
2,000,000	J & J	Contra Costa Water Co. 5%	100	102	101½		101½		101½		101¾		100	102½
1,000,000	J & J	do do Gen. Mtg. 5%		97		97	96½	98	96½	98		97½		97½
623,000	F M A N	Edison Light & Power 6%	111	119	111	119	111	119	111	119	111	119		116
650,000	M & S	Ferries & Cliff Ho. Ry. 6%	103¾		103¾		103½		103½		103½		103½	
671,000	A & O	Geary St. Ry. 5%	52		52		52		52		52		52	
610,000	M & N	Honolulu R. T. & L. Co. 6%	105¼		105¼		105¼		105¼		105¼		105¼	
300,000	A & O	Lake Tahoe Ry. & T. Co. 5%												
500,000	J & J	Los Angeles Elec. Co. 5%	100		100		100		100		100		100	
1,300,000	J & J	Los Angeles Gas & Elec. Co. 5%	99½		99½		99½			101½		101½		101½
5,000,000	A & O	Los Angeles Ry. 5%	106		106		106¼		106¼	108	106¾		107	
1,000,000	A & O	Los Angeles Lighting Gd. 5%		105		105		105		105		105		105
1,500,000	A & O	Los Angeles Pac. R. R., 1st Con. Mtg. 5%		103½		103½		103½		103½		103½	103	103¾
3,030,000	M & S	L. A. Pac. R. R. of Cal. 5%		101½		101½		101½		101				
3,000,000	J & J	Market Street Cable 6%		106	105		107		107		107		107	
5,141,000	M & S	do Ry., 1st Cons. Mtg. 5%		107½				105		105		105		105
100,000	A & O	Mill Valley & Mt. Tamalpais S.Ry. 5%	103		103		103		103		103		103	
4,751,000	A & O	Northern Ry. Co. of (Cal.) 5%	109½		109½	110½	110		110¼		110½		111	112
1,498,000	J & J	North Pacific Coast R. R. 5%	100		100		100		100		100		100	
1,074,000	J & D	Northern Cal. Railway 5%			100	108		106		106		106		107½
980,000	J & D	Northern Cal. Power Co. 5%		100		100		100		100		100		100
6,000,000	A & O	Northern Electric Co. 5%		97½		97½		97½		97½		97½		97½
1,000,000	M & S	Oakland Gas Light and H. 5%	100	106	100	106	101½		100		104		103	106
1,374,000	J & J	Oakland Transit Co. 6%	109½		110	112	110		110	112	110		110½	
1,600,000	J & J	Oakland Transit 5%	101½		101½		101½		101½		102½		102½	
1,326,000	J & J	Oakland Transit Con. 5%	100		100		100		100		100		101	
7,000,000	J & J	Oakland Traction Con. 5%		100		100		100		100	100		100	
1,500,000	J & J	Oakland Water Co. gtd. 5%		99		99		99		99		99		99
2,000,000	A & O	Omnibus Cable Ry. 6%	112	118	112	118	112	118	112	118	112	118	112	118
1,149,000	S D M J	Pacific Gas Imp. 4%												95
8,494,000	J & J	Pacific Electric Ry. Co. 5%	102	103	102	103	102	102½	102	102¼	102	102½	102	
4,491,000	J & J	Pacific Light & Power Co. 5%		100½		100½		100½		100½		100½		100
3,000,000	J & J	Pacific Tel. & Tel. Co. 5%		102½		102½		102½		102½		102½		104
350,000	J & J	Park & Cliff House Ry. 6%	100		100			104		104		104		
250,000	J & J	Park & Ocean R. R. 6%		112½		112½		112½		112½		112½		112½
700,000	M & S	Powell Street Railway 6%		107½		107½		107½		107½		107½		107½
2,500,000	M & N	Sacramento Elec. Gas & Ry. 5%		99½	97½		98	100	98		98⅜	100	98	100
6,000,000	A & O	S. F. & S. J. Valley Ry. 5%	110		111	115	110		110		111		111	
3,000,000	J & J	S. F., Oak. & San Jose Ry. 5%	103	105		105		105	102½	105	102	104½		105
1,500,000	J & J	do do 2d Mtg. 5%		101		101		101		101		101		101
1,500,000	A & O	S. J. & S. Clara Co. R. R. 4½%		91		91		91		91		91		91
642,000	A & O	Sierra Ry. of Cal. 6%	107		107		108½		108½		108½		108½	
6,000,000	J & J	S. P. R. R. of Arizona 6% (1909)	103½		103½		103¾		103¾		103¾		103¾	
4,000,000	J & J	do do do (1910)	104		104	104¼	104		104		104		104	
5,116,000	A & O	S. P. R. R. of Cal. 6% (1912)	105		105		105		105		105			110
4,127,500	M & N	S. P. R. R. of. Cal., 1st c. gtd. 5%	114		114		114		114		114	116½	113⅝	116⅞
3,533,000	A & O	S. P. Branch Ry. of Cal., 6%	122½		122½	127½	123		123½		124		123½	
81,178,000	J & J	S. P. R. R. Co., 1st Ref'd'g. 4%	90		90			91½	90½		90		90¾	
17,500,000	J & D	Spring Valley Water Co. Gen. Mtg. 4%		85¼	84	85¼		85½		85½		86		86
300,000	M & S	Stockton Gas & Elec. Co. 6%	100		100		100		100		100		100	
2,000,000	J & J	United Gas & Elec. Co. 5%												
20,000,000	A & O	United R. R. of S. F. 4%	69⅞		70		70		70⅛		70⅛		70	70¼
2,500,000	M & N	Valleys Counties Power Co. 5%		100¼		100¼		100		100		100		100
		Water Stocks.												
		Contra Costa	59		59		59		59			62		62
6,000	Quarterly	Marin County		62		62		62		62		62		62
280,000		Spring Valley Water Co.	19	19¼	19¼	19½	19½	19¾	20	20¼	20	20¼	19¾	20
		Gas and Electric Stocks.												
37,500		Martel Power Co.												
9,340		Mutual Electric Light Co. (Ctfs.)	4½		4½		4½		4½		4½		4½	
37,336		do (Extended Ctfs.)	12	13	12	13	12	13	12	13	12	13	12	13
40,000	Monthly	Pacific Lighting Co.	55		55		55		55		55		55	
12,000		Stockton Gas & Elec. Co.	52		52		52		52		52		52	
		Street Railroad Stocks.												
10,000		California		142½		142½		142½		142½		142½		142½
10,000		Geary		41		41		41		41		41		41
10,000		Presidio		25		25		25		25		25		25
	Semi-an.	Associated Oil Co.	33¼	33½	33¼	33⅜	33	34	33½		34⅛		34⅛	34¾
1,625	Quarterly	Mill Valley & Mt. Tamalpais S. Ry.		110		110		110		110		110		110
180,000	Quarterly	Pac. Tel. & Tel. Co. (Pfd.)	75	95	75	95		97½		97½		97½		97½
180,000		Pac. Tel. & Tel. Co. (Common)	7½		7½		7½		7½		7½		7½	

Unlisted Securities

Outstanding	Interest	Security	June 7 Bid	June 7 Asked	June 8 Bid	June 8 Asked	June 10 Bid	June 10 Asked	June 11 Bid	June 11 Asked	June 12 Bid	June 12 Asked	June 13 Bid	June 13 Asked
750,000	A & O	Bay Counties Power Co. 6%		103		103		103		103		103		103
745,000	M & S	Blue Lakes Water Co. 6%												
2,000,000	A & O	California Northwestern Ry. 5%		108		108		108		108		108		108
160,000	J A J O	Marin County Water 5%		100		100		100		100		100		100
600,000	J & J	Risdon Iron Works 5%		100		100		100		100		100		100
500,000	M & S	S. F. Dry Dock 5%		109		109		109		109		109		109
8,000,000	M & N	S. F. Gas & Electric 4½%		95		95		95		95		95		93
3,926,000	J & J	S. F. & North Pacific Ry. 5%	102½		102⅞		102½		102¾		102¾		103	103¼
5,500,000	J & J	South Pacific Coast Ry. 4%		95		95		95		95		95		95
		Standard Electric Co. 5%		92½		92½		92½		92½		92½		92½
		do do Gtd. 5%		95		95		95		95		95		95
750,000	J & J	Sunset Tel. & Tel. Co. 6%												
2,250,000	A & O	Sunset Tel. & Tel. Co. 5%		105¼		105¼		105¼		105¼		105¼		105¼
1,000,000	M & N	Sutter Street Railway 5%		105		105		105		105		105		105
		Stocks.												
50,000	Monthly	Gas Consumers' Association												
100,000	Monthly	Northern Cal. Power Co	20		20½		20		20		20	21½	20	21½
		Pac. Gas & Elec. (Pfd.)		50		50		50		50		50		50
		Santa Cruz Port. Cement	55	60	55	60		60		60		60		60
		Standard Port. Cement (New)		65		65		65		65		65		65
50,000	Monthly	Truckee Electric Co.	15	16½		16		16	15	16	15	16		16

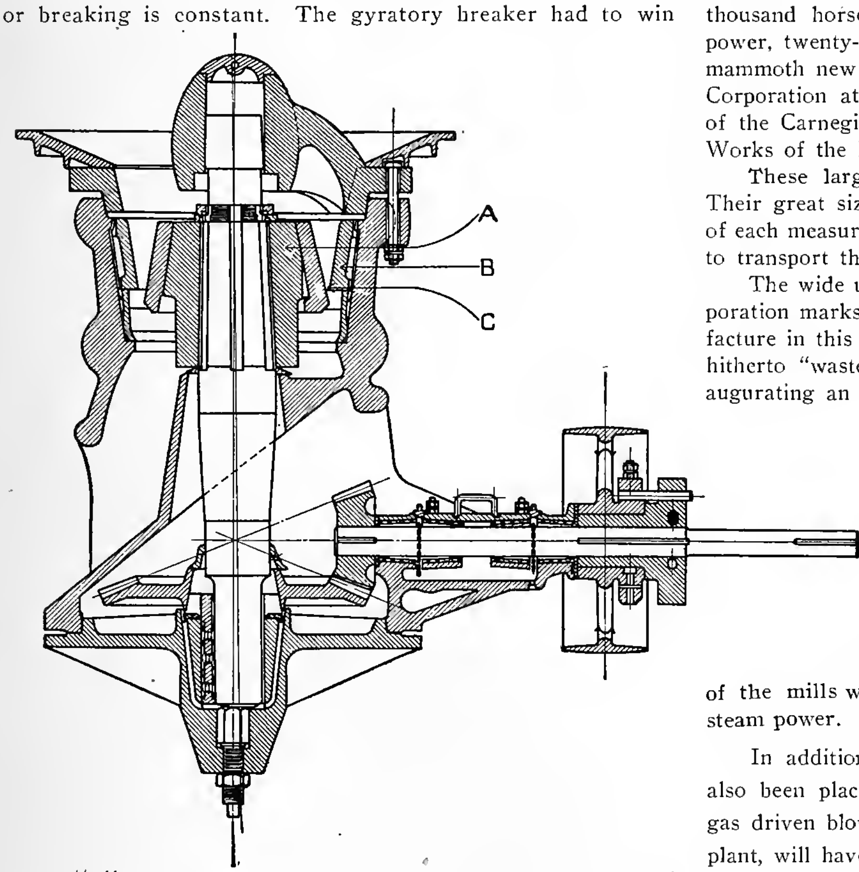
INDUSTRIAL

"GATES" BREAKERS.

Not least among the industrial features to be shown in connection with the Jamestown Exposition will be an exhibit made by Allis-Chalmers Company, of the "Gates" Breakers for crushing ore, rock and other materials which require for their reduction a powerful machine.

This breaker, which is of the so-called "Gyratory" type, was invented some years ago, to overcome the numerous objections to the jaw crusher, the only machine then known that could be depended upon to perform the service required.

The jaw crusher was of limited capacity, its product was not uniform and the machine itself was subject to frequent breakages, due to the severe shocks it had to sustain. These shocks are intermittent, and such a machine must have strength far in excess of what is required when the crushing or breaking is constant. The gyratory breaker had to win its way to favor against the prejudices of those who, from long using, had become accustomed to former types of machines, but to-day it has gained full recognition. Its introduction has given employment to vast numbers of men in stone quarries and mines, and has reduced the cost of breaking stone to a minimum. This has led to a more extended use of crushed stone for railroad ballast, for concrete work and for road-making material. The cost of producing the metals has also been greatly lowered by the installation of this machine to break up ore and flux.



STYLE "D" GATES BREAKRE WITH SHORT HEAD AND CONCAVES

From the time of the first application of the gyratory principle to rock breaking, Gates gyratory rock breakers have been built by Allis-Chalmers Company, and the development of the machines to meet growing needs has never lagged. More than 6,000 Gates crushers are in use, distributed in all parts of the world.

The phenomenal use of concrete construction during the past two or three years has carried with it such a large demand for finely-crushed stone that, taken in connection with the large quantity of broken rock needed in road construction, ballasting and ordinary building operations, the crushing industry has now become one of very great magnitude. It is, therefore, anticipated by the Exposition authorities that among the visitors to the great Fair, many will be attracted to the Allis-Chalmers Company's breaker exhibit, which may be found in Section 8 of the Machinery and Transportation Building.

LARGEST INDIVIDUAL ORDER FOR GAS ENGINES.

The largest single order for gas engines ever placed in this country, and for the largest engine of this type ever built, has recently been awarded by the United States Steel Corporation to Allis-Chalmers Company, Milwaukee, Wis. Within the past year this company has taken orders for thirty-six gas engines of four thousand horsepower each, or an aggregate of 144,000 horsepower, twenty-five of which are to be installed as a part of the mammoth new plant now in course of construction by the Steel Corporation at Gary, Indiana; seven for the Homestead plant of the Carnegie Steel Company, and four in the South Chicago Works of the Illinois Steel Company.

These large gas engines weigh 1,500,000 pounds apiece Their great size is also demonstrated by the fact that the shaft of each measures three feet in diameter. It will require 2300 cars to transport these machines.

The wide use of gas engines by the United States Steel Corporation marks an important step in the progress of steel manufacture in this country, as they are designed to operate upon the hitherto "waste" gas developed by the blast furnaces; thus inaugurating an important economy in steel production.

The majority of the Allis-Chalmers gas engines on order will drive electric generators of Standard Allis-Chalmers type, twenty-five cycle, three phase. These machines are to be used for generating the necessary power to operate the heavy induction motor driven rolls, the tilting and feed tables for the various passes, the hot saws, hot and cold pull-ups, transfer tables, straightening machines, and cold saws, and other auxiliary machinery of the mills which are now ordinarily operated by means of steam power.

In addition to the gas driven electrical units, orders have also been placed with the Allis-Chalmers Company for twelve gas driven blowing engines. The Indiana Steel Company, Gary plant, will have eight blowing engines, and the Homestead plant of the Carnegie Steel Company has ordered the remaining four units. Each blowing engine has a capaicty of 3500 horsepower, and will deliver 30,000 cubic feet of free air per minute against a pressure of eighteen pounds per square inch which is ordinarily the maximum. Eleven of the gas driven blowing engines purchased by the Steel Company's plants will be equipped with "slick" type blowing tubs, the Amercian patent rights covering which are owned by Allis-Chalmers Company.

In steel plants where steam driven blowing engines have heretofore been using steam furnished by boilers utilizing waste gases from blast furnaces, it is ordinarily found that the amount of gas is at times not sufficient to supply the required power for this purpose only. But the same gas when used in gas engines not only furnishes sufficient gas for supplying all the air required by the furnaces, but also a considerable quantity over and above the requirements, which is used, as in the present instance, for driving gas engine units furnishing sufficient power for the other uses common to the steel mill.

JAMESTOWN EXHIBIT OF H. W. JOHNS-MANVILLE COMPANY.

The H. W. Johns-Manville Company have a large and interesting exhibit at the Jamestown Exposition. Probably the most notable feature of this exhibition was the "Victor" Combination Meter, a variety of forms of which were shown, including switchboard, portable and automobile types. These instruments, which have been described in our columns before, possess the unique feature of giving a simultaneous reading of volts, amperes, watts, and horsepower, on one dial. The instruments are manufactured at the new instrument works of the company in Brooklyn, N. Y., which is one of the best equipped factories of its kind in the country.

A new "automobile" type of meter was exhibited, which attracted special attention. This instrument is intended for electric automobiles, runabouts, etc. It is mounted on a tripod stand and provided with a ball and socket arrangement, by which the instrument can be turned at any desired angle to suit the convenience of the operator. This arrangement also permits it to be turned sideways, for use when the machine is being charged.

Quite a variety of the regular switchboard and portable meters were also shown, in various styles and finishes.

Among the other devices exhibited should be mentioned "Noark" subway and service boxes, of one, two and three pole construction, and 250, 600 and 2,500 volt capacity. These boxes are absolutely watertight, being designed and tested to withstand a pressure of twenty-five pounds per square inch without leaking, and are therefore suitable for the most severe conditions. Also a complete line of "Noark" national standard fuse blocks and accessories, as well as line material devices, were shown. Another feature worthy of mention is "Transite" asbestos fireproof doors, for high tension transformers and switches. These doors are designed for the protection of apparatus from short circuiting; also to prevent persons coming into contact with the live parts. They are made of "transite" asbestos fireproof lumber, a material which possesses the unique feature of being absolutely fireproof, and, at the same time, an excellent insulator.

VENTILATION OF THE BOSTON SUBWAY.

In the Boston subway the change of air once in ten minutes, which is produced by a number of fans, is sufficient to meet all ordinary conditions. But the corresponding rate of flow which is only one linear foot per second from each station toward each center of discharge is extremely low. .Such a low rate of flow (which is a measure of the vacuum produced) would leave any ventilating system practically powerless to overcome the effect of ordinary atmospheric changes. A difference of only .01 inch of water is sufficient to produce a velocity about six times greater than that planned for the subway. The result when large open portals and numerous entrances and exits, to say nothing of moving trains, afford ample opportunity for the creation of pressure differences much greater than .01 inch has been to render the ventilation decidedly erratic.

Under these conditions the fan becomes merely local in its effect. It is practically powerless to control the direction of such currents at such differences as exist in the subway. In a word, so long as the subway connects through large openings with the outer atmosphere it is impossible for fans of the capacity here installed to properly control the flow of air. The trouble in the case of this installation is not with the individual fans, which are of the Sturtevant open cone-type, but with their size as determined by the subway engineers, for a fan can mechanically meet any desired requirements. The problem is one of volume and velocity, which must be sufficient to insure the maintenance of a pressure difference which cannot be overcome by atmospheric conditions. The entire installation suggests the false economy which is all too likely to be observed when ventilation is to be provided.

Mechanical draft apparatus is to be furnished by B. F. Sturtevant Company of Boston, Mass., for boilers in the following power plants: Penna, Fort Wayne Chicago Railway, Allegheny, Pa.; Acushnet Mills, New Bedford, Mass.; State Hospital for the Insane, Howard, R. I.; Syracuse Malleable Iron Works, Syracuse, N. Y.; Union Light, Heat & Power Co., Fargo, N. D.; The Fisheries Co., Fall River, Mass.; Wood Worsted Mills, Lawrence, Mass.; El Paso Electric Railroad Co., El Paso, Texas; Russia Cement Co., Anacortes, Wash.; and Hazard Manufacturing Co., Wilkesbarre, Pa.

APPROXIMATE RULE FOR SIZE OF WIRES FOR THREE-PHASE TRANSMISSION LINES.

The table given below is for use in making rough estimates for the sizes of wires for three-phase transmission service, as in the following example:

Required: The size of wires to deliver 500 kilowatts at 6000 volts, at the end of a three-phase line 12 miles long, allowing an energy loss of 10 per cent and a power factor of 85 per cent. If the example called for the transmission of 100 kilowatts (on which Table A is based), we should look in the 6000-volt column for the nearest figure to the given distance, and take the size wire corresponding. But the example calls for the transmission of five times this amount of power, and the size of the wire varies directly as the distance which in this case is 12 miles. Therefore we look for the product 5x12 =60 in the 6000-volt column of Table A. The nearest value is 60.44 and the size wire corresponding is No. 00, which is, therefore, the size capable of transmitting 100 kilowatts over a line 60.44 miles long, or 500 kilowatts over a line 12 miles long as required by the example.

If it is desired to ascertain the size wires which will give an energy loss of 5 per cent, or one-half the loss for which the table is computed, it is only necessary to multiply the value obtained by 2 since the diameter varies directly as the per cent energy loss.

TABLE A.

Distances to which 100 kilowatts three-phase current can be transmitted over different sizes of wires at different potentials, assuming an energy loss of 10 per cent and a power facor of 85 per cent.—Furnished by The General Eldctric Co.

Number B. & S.	Area in Circular Mils.	Distance of Transmission for Vatious Potentials at Receiving End										
		2,000	3,000	4,000	5,000	6,000	8,000	10,000	12,000	15,000	20,000	25,000	30,000
6	26,250	1.32	2.98	5.28	8.27	11.92	21.12	33.1	47.68	74.50	132.4	206.75	298
5	33,100	1.66	3.75	6.64	10.40	15.00	26.56	41.6	60.00	93.75	166.4	260.00	375
4	41,740	2.10	4.74	8.40	13.15	18.96	33.60	52.6	75.84	118.50	210.4	328.75	474
3	52,630	2.54	5.96	10.16	16.55	23.84	40.64	66.2	95.36	149.00	254.8	413.75	596
2	66,370	3.33	7.51	13.32	20.85	30.04	53.28	83.4	120.16	187.75	333.6	521.25	751
1	83,690	4.21	9.48	16.84	26.32	37.92	67.36	105.3	151.68	212.00	421.2	658.00	948
0	105,500	5.29	11.92	21.16	33.10	47.68	84.64	132.4	191.72	298.00	529.6	827.50	1192
00	133,100	6.71	15.11	26.84	41.97	60.44	107.36	167.9	241.76	377.75	671.6	1049.25	1511
000	167,800	8.45	19.04	33.80	52.85	76.16	135.20	211.4	304.64	476.00	845.6	1321.25	1904
0000	211,600	10.62	23.92	42.48	66.42	95.68	169.92	265.7	382.72	598.00	1062.8	1660.50	2392
	250,000	12.58	28.33	50.32	78.67	113.32	201.28	314.7	453.28	708.25	1258.8	1966.75	2833
	500,000	25.17	56.66	100.68	157.35	226.64	402.72	629.4	906.56	1416.50	2517.6	3933.75	5666

NEWS NOTES

ORGANIZATION FOR OPEN SHOP.

Within the past three weeks local capital and the interests connected with the building industry have been unionizing to meet the abnormal conditions imposed by union labor. The movement began about the time of the action of the Builders' Exchange in appointing a committee to work for a stable rate of wages and unchanged prices for building material for one year's time.

Large estates and other property owners have been laying plans at numerous meetings to continue building construction on the open-shop basis, in case the unions are unable to furnish the necessary amount of labor. Owners representing $8,000,000 of immediate construction work, and including some of the city's largest capitalists, have agreed to shut down work on large buildings on account of the scarcity of workmen needed to rebuild the city, and the fact that the unions will not permit the increase of the body of laborers by allowing non-union men to work without intimidation and violence.

One of the leaders in the movement declares there are but 35,000 available workers, and that reconstruction demands 90,000.

Local building interests have brought about the organization of a syndicate of outside capitalists, who will advance $10,000,000 within the next month, to be used in construction on the open-shop basis only. It is said that a few San Franciscans have subscribed funds to the syndicate.

Another combination in the building line is composed of contractors, large construction companies and material men who favor the open-shop plan and agree to build or furnish material on that principle only.

A representative of one of the interests said: "We have lined up one organization of property owners and large estates, who have agreed to shut down immediate construction work, which would cost $8,000,000, until the normal rate of wages is restored. In the event of the unions refusing to reduce wages, this organization will furnish the necessary amount of labor required while the buildings are being constructed on an open-shop basis. The construction companies and material men have joined in the agreement, and a syndicate, which has just been incorporated outside of this State, will furnish money for open-shop building.

"There is no desire to resort to this defense if the unions will agree to a normal rate of wages and furnish the necessary amount of labor required or allow the employment without interference of non-union men in the event of their being unable to supply the labor."

TRANSMISSION.

Santa Rosa, Cal.—It is being proposed to grant a franchise to Frank M. Burris, to erect and maintain wire lines for transmission of electricity for heat, power and light and other purposes, and telegraph and telephone lines, incidental thereto along highway in Sonoma County. Bids will be received for the franchise up to July 3rd.

St. Helena, Cal.—Sealed bids will be received by the Board of Trustees up to 8 p. m., July 9th, 1907, for the sale of a franchise that has been applied for by Henry Brown to erect and maintain along the streets poles and wires for transmission, electric light, heat and power, in St. Helena.

IRON WORKERS RESUME WORK.

The iron workers' strike is over.

San Francisco Lodge No. 68, Association of Machinists, have ratified the agreement proposed jointly by the Metal Trades Association and by the Iron Trades Council and ratified by the majority of unions affiliated with the Council.

The action of that lodge, taken at a special meeting Wednesday evening, it is understood, will be accepted as final by the other lodges of machinists of this city and vicinity. It terminates the strike in the iron trades and insures industrial peace for at least three years.

Twice within the week has that lodge rejected the same terms, though the Iron Trades Council, of which the lodge is a component part, has ratified the agreement on two occasions, and it was expected that the affiliated unions and lodges, including the machinists, would abide by and confirm the action of the central council. The California Metal Trades Association, accepting the action of the Iron Trades Council as binding upon all its affiliated unions, signed the agreement with the duly authorized representatives of the council and announced that all machine shops, foundries and ship-building plants would reopen on last Monday morning.

Notices were posted in front of the shops to that effect, and the men who had been on strike for weeks hurried to apply for work at their former places.

The machinists held a special meeting Saturday evening, but instead of rescinding their former action and ratifying the agreement, they again rejected it. This act so exasperated the employers that the committee having the matter in charge hurredly called a conference of the Metal Trades Association and decided to keep the shops closed until all the unions in the iron trades should accept the terms.

One lodge of boilermakers and some few other unions affiliated with the Iron Trades Council had also rejected the agreement. On last Monday morning several thousand mechanics and workmen applied at the shops ready to go to work, but were turned away. A few shops, whose owners had not been informed in time, opened their shops and started work, but closed as soon as they learned of the action of the association.

The influential members of the various unions and recognized leaders renewed their efforts with the members of Machinists' Lodge, No. 68, in an effort to have that lodge accept the terms, which they considered the best obtainable at present.

ILLUMINATION.

Yuma, Ariz.—Seth Hartley has returned to Yuma from Colton and will superintend the immediate construction of the local gas plant. It will be in operation by July 15th.

Alameda, Cal.—The Electricity Committee of the City Council reported to that body recently its proposed plans for the operation of the municipal electric light plant. The plan calls for the construction of a new fire proof building, the installation of a new generator unit, a new boiler, and the extending of the power and electric light service. The estimated cost is $58,000. In case the money is allowed, $18,000 will be expended on the new building, $25,000 will go for the new unit, $6,000 for the new boiler, $1,800 for improving the power service, and $1,500 for improving the lighting service.

TELEPHONE AND TELEGRAPH.

Prineville, Ore.—The Pioneer Telephone Company has absorbed several local lines in Burns County.

Tacoma, Wash.—Home Telephone Company expects to begin business, June 25, with 400 business phones.

Albridge, Mont.—The Montana Coal & Coke Company will make improvements and extensions to its plant.

Stevensville, Mont.—Farmers in vicinity of Burnt Fork region are attempting organization of a rural telephone company.

Anacortes, Wash.—The Independent Telephone Company, which had a franchise for a system here, has decided not to build.

Helena, Mont.—H. E. Mott, engineer of construction, is preparing to put Independent Telephone lines underground. This is an automatic system.

Prosser, Wash.—New switchboards are being placed in office of Yakima Valley Telephone Company, and will later be installed at Toppenish, Wapato and Mabton.

Helena, Mont.—The Gould-Lincoln Telephone Company, with capital of $10,000, has been incorporated by H. L. Miller, J. A. Russell, of Chicago, and R. R. Johnson, of Los Angeles, and will build a line 150 miles long in Blackfoot country.

Bremerton, Wash.—Paulsbo Rural Telephone Company has been granted a franchise for the lines in Kitsap County.

Davenport, Wash.—N. T. Caton, city attorney, is opposed to granting telephone franchises to J. J. Nichols and associates.

Boise, Ida.—A new stamp mill is being installed at the Black Pearl Mine, to take the place of the Elspass mills, now in use. The mill will be operated by electric power from the Payette power plant. An auxiliary steam plant will be built to insure constant operation of the mill.

Sonora, Cal.—The Government telephone line from Sonora to the range camp near Smith's Station, ten miles beyond Groveland, has been completed, and Supervisor S. L. N. Ellis, of the Forest Reserve, has been notified that the necessary appropriation has been made to continue the line to the camp at Anderson Valley, on Bull Creek, a distance of twenty-two miles.

Rhyolite, Nev.—Fred M. Hess, principal owner of the Inyo Telephone Company, is preparing to extend the service to this and all the Owens Valley. Henry C. Lee, of Harron, Rickard & McCone, machinery agents, is here from Los Angeles. He will recommend that a branch office be put here for the sale of machinery. A branch will be started at Phoenix, Arizona.

Ely, Nev.—J. R. Marsh, manager of the White Pine Telephone Company, has returned from Salt Lake, where he held a conference with the officials of the Utah Independent Telephone Company, and states that he has made arrangements to connect the White Pine Line with the line leased to the Western Pacific by the Utah Independent Company. Later, he states, the White Pine County Company will connect with a line to be built to Tonopah, and then to Reno.

Coeur d'Alene, Ida.—A quantity of machinery, including a hoist, pump and a sawmill, has been ordered for the Legal Tender Mine on Prospect Gulch, near the Evolution Mine, in the Coeur d'Alenes. The sixteen claims of the group are now being surveyed for patent, after which the 80-foot shaft will be deepened to the 250-foot level. New buildings are to be erected, and the mine will be developed as rapidly as possible. About $15,000 will be spent on the improvements now planned.

WATERWORKS.

Emeryville, Cal.—Emeryville is to have a salt-water plant for street-sprinkling and fire-fighting purposes. The system is to be operated within a year, and will cost $50,000.

Rhyolite, Nev.—The actual work of installing the Ash Meadow Water System has been begun, and upon the completion of this enterprise Southern Nevada will have a water system that is second in magnitude only to the Owens River System, which is being installed by the City of Los Angeles. The new system will open the country for a radius of 100 miles, and will enable mining to be carried on in places now closed for lack of water.

San Francisco, Cal.—The stockholders of the Olympic Salt Water Company, which furnished the supply of ocean water to the Olympic Club and distributed it to other parts of the city prior to the fire, met and re-elected the old Board of Directors of the company, naming John D. Spreckels as president. Plans have already been made for rehabilitating the salt-water plant at once, and one of the first improvements to be made will be the establishment of a tub bath house with 500 baths on Geary Street, between Scott and Devisadero.

San Francisco, Cal.—Messages have been received from James D. Phelan, at Washington, to the effect that he had practically concluded negotiations with the federal authorities by which San Francisco would be enabled to secure possession of the Hetch-Hetchy system. For several years Mr. Phelan has been endeavoring to obtain the water rights for San Francisco. At the meeting of the Water Committee last week it was urged that the city's interest called for the acquisition of the Tuolumne supply, if that were feasible. This decision was reached after Captain Payson, president of the Spring Valley Water Company, had said that his corporation was financially unable to make the improvements necessary to meet the growing demands of the city. It was brought out that the summer months would find the city with an entirely inadequate supply, unless steps were taken at once to remedy matters. Present at the meeting were Capt. Payson, Col. W. H. Heuer, Walter Macarthur, C. H. Bentley, Isidor Jacobs, A. H. Vail, Frank J. Symmes and Michael Casey. The committee was formed primarily to find some means of improving the water supply of the city, either through co-operation with or the purchase of the Spring Valley plant, or the acquisition of some independent source.

OIL.

San Francisco, Cal.—The Southern Pacific is to spend $2,000,000 on a 265-mile oil pipe line from the Kern County oil fields to a point on San Francisco Bay, opposite this city. The line will consist of an 8-inch pipe for the entire distance, and along it there will be twenty-three pumping plants, each with two single or triple-compound duplex oil pumps, and at each pumping plant there will be a 750-horsepower battery of water-tube boilers in three units and two steel tank reservoirs for storage purposes.

Benicia, Cal.—Work on the oil refinery which Los Angeles and San Francisco capitalists are to build on the bay shore, between Vallejo and Benicia, will begin this week. Eighteen boiler makers will arrive from the East to erect the tanks, which will be the preliminary work at the Glen Cove site. David Fleischer, of San Francisco, acting as agent for the oil men, has procured a wharf franchise at that point, and will at once erect a big wharf.

TELEPHONES.

Ketchican, A.—A line between Hadley and Kasaan at Karta bay is planned.

North Yakima, Wash.—This city will soon have a new system, the Independent Telephone Company, Seattle being the applicant for a franchise.

Tacoma, Wash.—The Home Telephone Company will have about 400 phones installed in business houses by June 25th. Residence phones will be put in later.

Ketchican, A.—The Heckman telephone line is being relocated from Ketchikan to Ward's Cove. It is being strung along the beach instead of through the woods.

Aberdeen, Wash.—Council has cited E. P. Finch to appear and state why his franchise to build an independent telephone line should not be revoked and the $500 of bonus money retained.

Ellensburg, Wash.—Farmers' Telephone Company has completed its line to the Badger Pocket country, 17 miles east of here. The line is 35 miles in length and six trunk wires serve the subscribers.

Ilo, Ida.—The Nez Perce Co-operative Telephone Company will improve its lines. The building of an extension from Dublin to Lawter's canyon and the construction of a branch line from Nez Perce was authorized.

Coeur d'Alene, Ida.—The Interstate Telephone Company has just completed the installation of its system. Its board has a capacity for 500 lines, which will be doubled before the close of the year. J. W. Fisher is manager.

Davenport, Wash.—By members of the town council, the application of John Nichols and others for a franchise for a second telephone system was unanimously voted down. The present system, known as the Farm and City Telephone Exchange, is controlled by J. A. Hansen and is given service all over Lincoln and Stevens county.

Pomeroy, Wash.—Arrangements have been completed by the Pacific States Telephone Company for the installation of an automatic system to take the place of the town exchange at Pomeroy. A new switchboard will be put in also, to better accommodate the increasing demand. The town exchange was installed in 1904, when 11 instruments were put in as an experiment. Now there are 200 instruments in use, besides the farmers' line, which utilizes 100 instruments.

Spokane, Wash.—Fifty thousand dollars will be expended by the Home Telephone Company, of Spokane, on a building to be used as a substation. The company will erect two substations and a main exchange, the entire cost being $200,000, exclusive of equipment. John T. Huetter, contractor, has begun work on the foundation for the main exchange, and the structure will be rushed. W. W. Hindman, attorney, who is associated with Cyrus Happy, vice president of the company, announces that 4,000 instruments will be in operation December 1, 1907.

WATERWORKS.

Reno, Nev.—This city is to be supplied with water from Hunter Creek for domestic purposes. Twenty-inch wooden pipe, wrapped with steel cable, is piled along the duct at the west end of the city. The pipe is constructed of redwood and will be laid under ground.

OIL.

Bakersfield, Cal.—The Associated Oil Company is preparing to install a new first class boiler plant at McKittrick.

Bakersfield, Cal.—The Kern River Company is building a new reservoir of about 75,000 barrels capacity and will start drilling soon on the west line. The San Francisco McKittrick Company's wells, which have been closed down for two years, are now being cleaned out, and in about a week pumping will be resumed. A. B. Canfield is preparing to drill on his property at the north end. The wells at Midway will be opened this month.

Coalinga, Cal.—The residents of this place are greatly excited over an oil gusher which has been spouting at the rate of from 500 to 1,000 barrels a day for the last week. The well is owned by the Commercial Petroleum Company, of which M. L. Woy, of Fresno, is a heavy stockholder. Others are M. Madsen and W. W. Machen, of Fresno, Captain Madsen, of San Francisco, and the Associated Oil Company. The well is about four miles west of Coalinga. It is regarded by experts as a record breaker, and means a fortune to each of the lucky stockholders. The oil is of very light weight.

Bakersfield, Cal.—A party of well known residents of this city have acquired possession of eleven acres of valuable oil lands in Western Utah, and have formed the Bakersfield and Utah Oil Company to control the new lands, and will start development work on their property at once. The land is in the new Clear Lake oil fields, in Millard County, in the west-central part of the State, and is considered one of the most promising fields which have been recently discovered. Development work which has been done by "Oil King" Newhouse on adjoining property has proved so promising that he has quietly bought up all other available land in the fields with the exception of that owned by the Bakersfield men. A rig has been sent out and will be set up at once on their property. W. O. La Grange will act as general manager of the company. The other incorporators are F. G. Munzer, J. W. Brisco, W. T. Davis, J. J. Anderson, Geo. A. Damon, W. S. Johnson and J. S. Wildy. The company is capitalized at $500,000.

TRANSMISSION.

Georgetown, Cal.—P. E. Mageistadt passed through this place last week on his way to Rubicon. He is investigating the water flow below the Ralston Bridge with a view to installing an electric power plant at Eagle Bar or near it.

Crescent City, Cal.—The Crescent City Light, Water and Power Company is making preparations to install a plant near the mouth of Craigs Creek, emptying into the south fork of the Smith River several miles above its mouth. A concrete dam will be placed in the creek.

Lakeport, Cal.—Wm. M. Dean, general superintendent of the Snow Mountain Water and Power Company, came over from Ukiah last week to hold a meeting with the local officials of the Lake County Electric Light and Power Company, which is an allied corporation with the big Eel River Power plant. The local men present were H. V. Keeling, W. P. Mariner, M. S. Sayre, B. H. Henderson, and A. H. Spurr. They are holding off their operations until the main company gets the power delivered to the Lake County line. Mr. Dean said that electricity would be available in Lakeport for light, heating and power positively by November.

INCORPORATIONS.

San Francisco, Cal.—The Electrical Repair and Construction Works has been incorporated with a stock of $20,000, by C. R. Frazer, W. G. Lenhart and M. M. Frazer,

Los Angeles, Cal.—The Mission Spring Water Company has been incorporated with a capital stock of $150,000, by Edw. Hunter, E. G. Love, J. S. Gong, R. J. Long and G. L. Mosselle.

Los Angeles, Cal.—The Elysian Garden Water and Supply Company has been incorporated with a capital stock of $50,000, by Edw. Greenfield, J. S. Clark, J. W. Newbern and L. P. Jacquth.

San Francisco, Cal.—The Thirty-Six Oil Company has been incorporated with a capital stock of $100,000, by Mary J. Thomas, Ella M. Goe, C. L. Hovey, A. E. Bolton and W. B. Beaizley.

Los Angeles, Cal.—The Esperanza Petroleum Company has been incorporated with a capital stock of $600,000, by J. F. Goodwin, Henry Werner, F. H. Gates, A. H. Froom and W. W. Dashiel.

Fresno, Cal.—The Blair Oil Company has been incorporated with a capital stock of $250,000, by Scott Blair, S. D. Porter, J. M. Hendrickson and H. C. Kerr, of Coalinga, and J. O. Hickman, of Hanford.

Stockton, Cal.—The Gate City Oil Company has been incorporated with a capital stock of $250,000. Directors: J. W. Mosher, of Sacramento; Ira E. Smith, J. F. Lynch and F. F. Giottonini, of Stockton.

Modesto, Cal.—The La Grange Water and Power Company has had its capital stock increased from 1,000 to 2,000 shares each. Directors: J. P. O'Brien, E. J. Epperson, E. W. Billet, J. W. Lilienthal, Albert Raymond and C. Elkus. Place of business, Goldfield, Nevada.

San Bernardino, Cal.—The Western Power and Water Company has organized and taken over the landholdings of the Poole-Westwater people along the Mojave River. A. F. Poole, Robert Westwater, a Cincinnati capitalist, J. P. Scott and others, are the incorporators. The capital stock is $600,000. It is understood that the Victor reservoir will now be a reality and that power plants, tunnels and other development work will go forward.

Denver, Colo.—Articles of incorporation were filed here June 5th, for the Idaho Nevada Power Company, with a capital stock of $7,500,000. The company has for its directors a number of Colorado Springs men, who are associated with eastern capitalists. Headquarters will be maintained in Denver. This concern, which will operate principally in Idaho and Nevada is to be an auxiliary to the Central Colorado Power Company, recently incorporated in Colorado with a capitalization of $22,000,000. In this concern is Myro Herrick, former Governor of Ohio; Thomas L. Walsh and David H. Moffat, multimillionaires of Colorado, and a number of other prominent capitalists of Colorado and the East.

WATERWORKS.

Gridley, Cal.—At a meeting of the Board of Trustees recently the subject of municipal water works was discussed, and tentative action taken looking to the purchase of pumps, power, and tanks. Estimates of cost were asked for.

Modesto, Cal.—The City Trustees at their last regular meeting decided to accept the proposition of Frank A. Cressey to install the pumping machinery, power, etc., and to pump such water as is needed to keep up the city supply for the consideration of $100 per month. The work of laying the mains to connect with the well will begin at once.

TRANSMISSION.

Los Angeles, Cal.—The Nevada, California, Electric Power Company, the new company which will transmit power to Ely and other mining camps and towns between Nevada, California, and that place, will also build to Ramsey.

Los Angeles, Cal.—An ordinance has been passed granting the Pacific Light and Power Company a franchise to operate and maintain an electric pole and wire system upon all public roads in the County of Los Angeles.

Ukiah, Cal.—Sealed bids will be received by the Board of Trustees up to July 13, 1907, for the purchase of a franchise asked for by the Snow Mountain Water & Power Company, to erect and maintain for the transmission of electricity for heat, power and light and other purposes and telegraph and telephone lines along certain streets and highways in the town of Potter Valley.

Martinez, Cal.—It being proposed to grant a franchise to erect and operate in Contra Costa County all piers, mast poles, etc., upon which to suspend wires, or other appliances for transmitting electricity and to lay cables and other appliances for transmitting electricity for all purposes, the Board of Supervisors will receive written tenders and offers for such franchise, on July 1.

Goldfield, Nev.—The problem for electrical power for Wonder and adjacent camps has been solved after months of hard work on the part of J. D. Jewett, formerly consulting engineer for the S. P. Co. at San Jose, Cal., and G. H. Richardson, of Wonder. Water has been discovered in Bevis and Anderson canyons to furnish 800 horsepower. All that will be necessary will be a dam fifty feet high and thirty feet at base and twenty feet on top.

Downieville, Cal.—Word has reached this place of the destruction of the very expensive electric plant owned by the Four Hills Company, situated in the extreme northern part of Sierra County. Parts of the house were carried down the canyon for half a mile. This was the most complete plant in Sierra County, consisting of two 2,300-volt generators run by water power under 960 feet vertical pressure. The plant was built at an enormous expense, and its loss will be a heavy blow to the Four Hills Company.

Sacramento, Cal.—Col. F. C. Chadbourne and Col. H Banester, of San Francisco, are in Plumas County in the interest of a great power development plant near Quincy. Col. Chadhourne secured the water right in two canyons in Plumas four years ago, with the intention of holding them for ten or a dozen years, when he was convinced that they would become valuable. That time came several years ahead of his anticipations, and he and Col. Banester proposed to begin forthwith building the necessary dams and other structures for the generation of 60,000 horse power. Enormous quantities of cement have been purchased for the undertaking, which will rank the largest electric enterprise in California, save the establishment under construction by the Great Western Power Company, which will supply energy for the operation of the trains of the Western Pacific. Colonel Chadbourne says that his company has orders for all the electricity that it can generate. Colonel Chadbourne verified the stupendous work being done in the way of electrical development by the Western Power Company for the Western Pacific. He says: "It is true that the Gould lines will be operated in California by electricity. While the Western Power Company will have, as you stated, 100,000 horsepower, it will be unequal to demand for power. However, there will be plenty of opportunity for the company to add to its equipment. It is prepared to utilize the additional resources as the occasion requires.

TRANSPORTATION.

El Paso, Tex.—The electric line between El Paso and Las Cruces is now assured. Chicago parties are back of the enterprise. Application for a franchise will be made in a few days.

Los Angeles, Cal.—Residents of Euclid Heights and the southern half of the Ninth Ward are jubilant over the possibility of early operation of electric cars in that section of the city, out Hollenbeck Avenue and on to Whittier.

Portland, Ore.—With the announcement of building an electric line from Portland to Ranier, the Ranier Electric Company has been organized, with a capital stock of $25,000. Articles of incorporation were filed last week. The principal offices of the corporation will be at Portland. The incorporators are Alex Sweek, Carleton Lewis and W. C. Morris.

Fresno, Cal.—Manager A. G. Wishon, of the San Joaquin Power Co., has returned from Crane Valley, where he went to inspect the work in progress there. He reports that the survey for the electric line to Yosemite Valley will be completed in two or three days more. This will mark the close of the preliminary stage of the mountain line. The financing of the project will be cared for by the Huntington main office in Los Angeles.

Napa, Cal.—The work on the extension of the Vallejo, Benicia and Napa Valley Electric Railroad is progressing rapidly, and already three miles of track, which will eventually extend to St. Helena, have been completed. The delayed arrival of the material for the road has changed the plans of the company officials, who had expected to have the cars in operation up the valley by June 1st. The first car will be sent north from this city on July 4th. The construction of this line is being watched with much interest by the residents of this as well as of Lake County, for it will open up the resources of both.

San Francisco, Cal.—Nothing can be done toward the construction of a municipal conduit electric power street car system on Geary Street during the next two or three weeks. Supervisor Gallagher says: "The budget, passed to print last week, will have to receive the Mayor's approval. We do not thing that he will veto the bill, as the measures of rehabilitation provided for in the budget have his warm support. Not until the Monday after the budget is adopted and approved will the Supervisors be in a position to give the engineers permission to go ahead."

Long Beach, Cal.—The Pacific Investment Company, of Los Angeles, has closed a deal by which it comes into possession of twenty acres of Seventh Street. The land is along the old right-of-way secured several years ago for a steam railroad. This right-of-way now belongs to the Pacific Electric Company, and it is reported that a line will be constructed entering the Alamitos district northeast of Signal Hill. It is said that the line will connect with the Monrovia line from Downey, and that residents of the latter city will give a $25,000-bonus to have the road constructed through the town.

Boise, Ida.—Water filings made in the office of the State Engineer indicate that it is the purpose of the Chicago, Milwaukee and St. Paul Railway Company to run its proposed line over the Bitter Root Range, between Montana and Idaho, by electricity. The filings were made in the name of the Idaho Water and Electric Power Company, just organized. They cover the waters of the St. Joe River and the north fork of the stream. The filings were made by I. N. Smith, of Lewiston, attorney for the railway interests. The water is to be used over and over again, according to the plans and specifications filed in the State Engineering Department, no less than sixteen dams being provided for. These, with the other works, will cost $923,000, and the sixteen plants will generate 46,000 horsepower.

TRANSPORTATION.

Berkeley, Cal.—Surveyors of the Oakland Traction Consolidated are running lines for the new cross-town road on Dwight Way. This line will be double-tracked in order to give fast service on this street to the bay. The line will begin at the corner of College Avenue, run down Dwight Way to Sixth Avenue, thence to University Avenue and down this to the bay. By this route the Dwight Way cars will cross every traction line in Berkeley. Another franchise held by the Traction Company is one beginning at the Claremont Hotel at the head of Russell Street, along Russell to Hillegass Avenue, to Ashby Avenue, to San Pablo Avenue. Work on this line will be commenced shortly.

Marysville, Cal.—The Northern Electric Company has commenced laying rails south from Marysville on the extension of its electric railroad toward Sacramento. A short delay will occur while the bridge across the south channel of the Yuba River is being completed, but construction trains will run to Sacramento by August 1st, and passenger service is to be established by September 1st. Trains will run each way every two hours. Five additional coaches are now being built for an extension of the service.

Newport, Cal.—O. H. Finley has received instructions from Port Orange to proceed as quickly as possible with the work of surveying a route for the proposed electric line from Old Newport Harbor to Santa Ana. The work is already under way.

CLASSIFIED LIST OF ADVERTISERS—CONTINUED

ILLUMINATION.

Vallejo, Cal.—Sealed bids are being received by the Board of Supervisors for the sale of a franchise to erect poles and wires for transmitting electricity for light, power and heat. The transmission system is to run over certain highways in Solano County.

St. Helena, Cal.—An ordinance has been passed by the Board of Trustees granting to Harry W. Pittman, of Calistoga, a franchise to construct, operate and maintain an electric light and power line. Mr. Pittman is given four months in which to begin construction, and twenty-four months in which to complete the system.

Berkeley, Cal.—The Berkeley Electric Lighting Company, branch of the Oakland Gas, Light and Heat Company, has announced extensive improvements soon to be made in Berkeley, including the erection of a $150,000 electric sub-station at the southeast corner of McGee Street and Hearst Avenue. The dangerous high tension wires on Grove Street will be moved to University Avenue and placed in conduits. The new sub-station will cover nearly an entire block. An expensive 250-kilowatt motor generating plant will be put in. The erection of the plant has been made necessary because of the heavy demands for power in Berkeley. John H. Pape, who has been connected with electric lighting in Berkeley for nineteen years, will be the superintendent of the new station.

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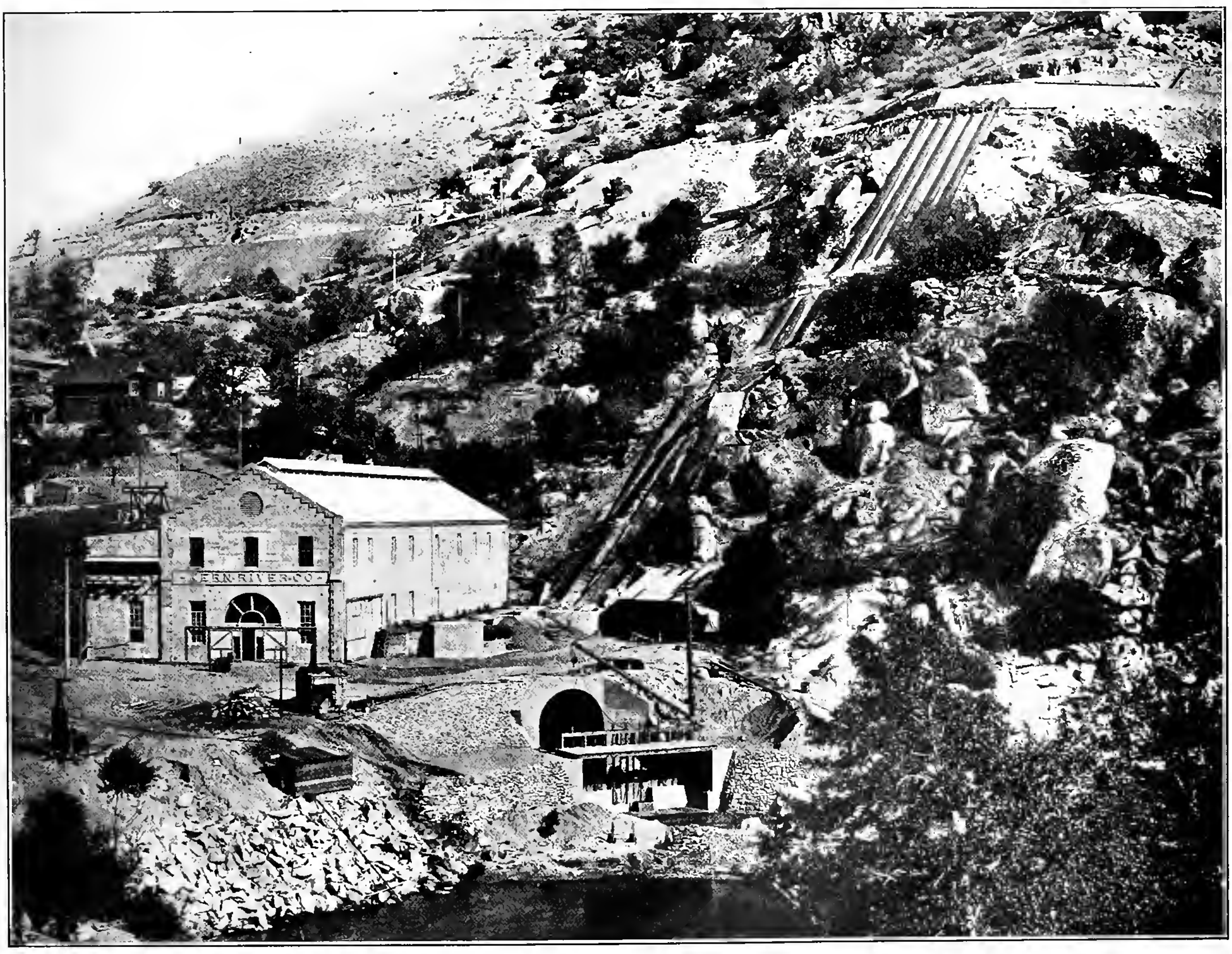
KERN RIVER PLANT, PACIFIC LIGHT & POWER CO.

One of the largest and the best equipped complete hydro-electric plants in the South is that of the Pacific Light & Power Company, known as the Borel Generating Station. The power house is situated about eighteen miles above the newly completed plant of the Edison Company on the banks of the Kern River, 120 miles from Los Angeles.

The entire flow of the north fork of the Kern River is



POWER HOUSE AND FORCE MAINS

diverted near Kernville and is carried in open canal, flumes and tunnels, 11½ miles to the power house on the banks of the river below. The minimum discharge at the point of diversion is 200 cubic feet per second, but is much greater than that at times, running up as high as 600 feet per second. At this flow the maximum capacity of the canal is reached.

Head Works.

The diverting dam, a substantial wooden structure, is built in two sections at the up-stream end of a low island in the river valley, one section consisting of ten 6-foot gates with stop planks for regulating the water, entering the settling basins leading to the canal, while the other section flow of the low water, but permitting the flood water to is a low weir, provided with stop-planks for diverting the pass over.

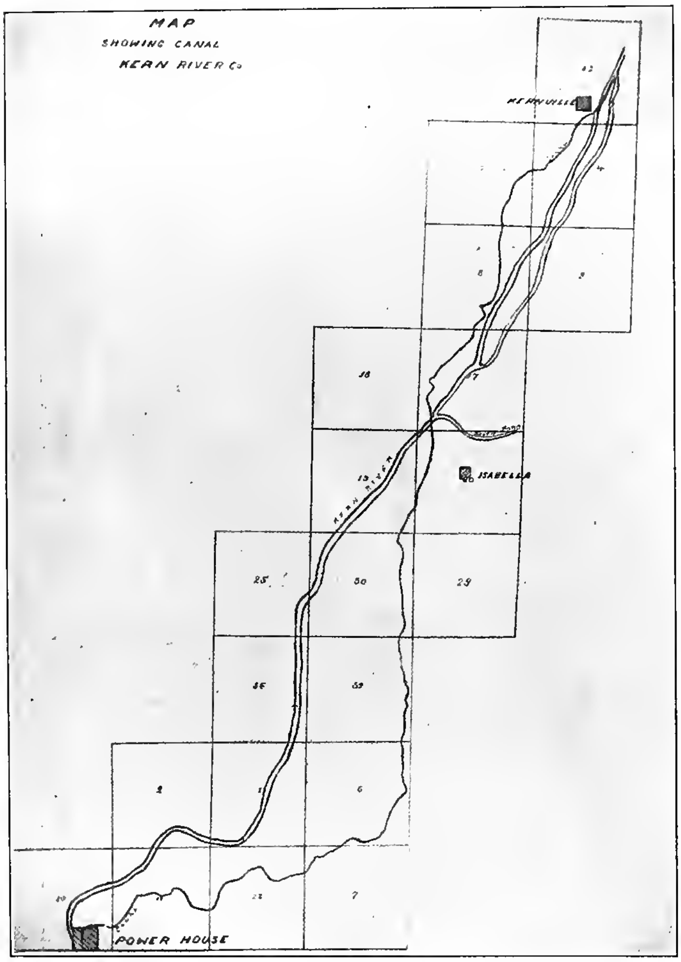
The settling basin is merely an elongated channel, 3200 feet long, averaging 400 feet wide and 10 feet deep. It is so constructed that it holds one-quarter of a million cubic feet of silt below the grade of the canal and impounds 4,000,000 cubic feet of water. The lower side of this basin is an artificial dike or embankment, riprapped with rock on the lower side and puddled with clay on the inner slope.

An overflow dam 224 feet long, and 11 feet high was constructed midway between the diverting dam and the headgates of the canal, of which there are six, each gate five feet wide operated by rack and pinion from a platform above.

Adjoining the headgates, which are enclosed between concrete masonry wings, a waste way has been constructed three feet below the canal grade, provided with nine sluice gates for discharging sand and silt back into the river channel.

Canals.

For the first eight miles the water is conveyed by means of a canal twenty-two feet wide at the bottom, forty-nine feet at the top, and nine feet deep, thus making the side slopes 1½ to 1. The embankment is ten feet deep with the same side slope, except in rock cuts where the slopes are 1 to 1. The grade of the fall is one foot in 5000 feet, with the exception of the last two miles, which has a grade of two feet in 5000 feet, and is fifteen feet wide at the bottom. When carrying 600 cubic feet per second the water in the canal is 7½ feet deep, running with a mean velocity of 2.5 feet per second. In sandy soil and wherever a leak might occur the canal was lined on sides and bottom with a cement concrete.



There are four tunnels on the line, aggregating 1922 feet in length. These tunnels are lined with cement concrete and have interior dimensions of ten feet in width and eight feet in depth, running with a grade of one foot per 1000 feet.

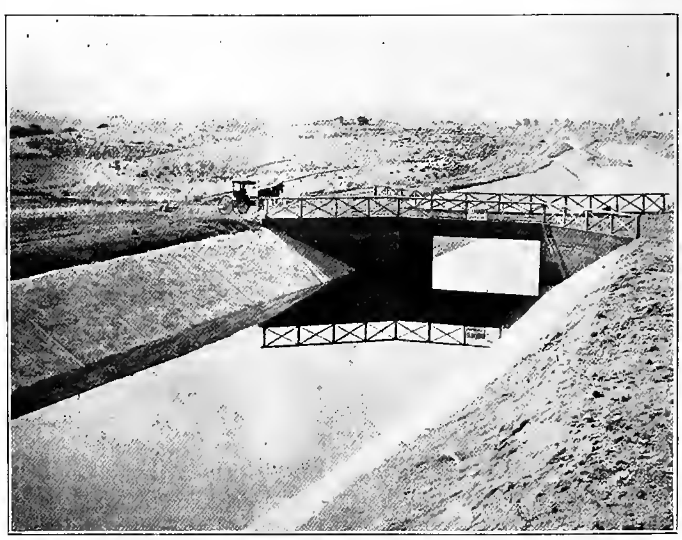
The fourteen flumes in the line aggregate 5572 feet in length. In the upper division the flumes are sixteen feet wide and eight feet deep, with the grade the same as that of the canal, while the lower division has a width of fourteen feet and the same depth. All flume headings are twelve feet long with concrete and wooden wings extending into the embankment.

CANAL AT HEAD WORKS

By far the most important structure on the line is the 1855-foot crossing over the Kern River. A trestle 1371 feet long and a four-span bridge 484 feet long, carrying a flume ten feet wide and eight feet deep on a grade of one foot in 1000, comprises this crossing. The bridge is of the combination type, with trusses eighteen feet apart and twenty-nine feet deep, resting on concrete piers, built on bed rock fifteen feet below the surface of the ground. The top of the flume is seventy-two feet above the water in the river. At the upper end of the crossing there is a reducing flume forty-five feet long, and immediately below this is a waste-way for emptying the canal into the river. All joints in the flume were beveled to admit calking with oakum, over which hot asphaltum was poured and allowed to cool. On the sides beaded battens were nailed below the joint into which hot asphaltum was poured.

The forebay, built on the steep mountain side, is merely an enlargement of the canal made by blasting out the solid rock, and provided with a sand box, screens, weir and sluice gates. The waste way discharges into a ravine to the river below the power house.

The total time for the water to pass from the headgates to the forebay is six hourse, twenty minutes, the length of the conduit system being approximately eleven and one-half miles.



OPEN CANAL SHOWING CEMENT LINING AND BRIDGE CROSSING

Force Main and Power-House Equipment.

As shown by the accompanying cut, the force main consists of five riveted steel pipes, each sixty inches in diameter and 550 feet long. These mains are uncovered, following the contour of the hill down to the power house, cemented together to prevent buckling under the pressure. Each pipe leads to a separate water wheel unit, anchored at the curves entering the power-house by concrete blocks. Thus, if one unit is hung up, the main supplying that unit with water power can be cut out by closing one gate outside the power house.

There are five water-wheel units, each unit consisting of one 66-inch, 3600-horsepower Stillwell-Bierce Smith Vaile Water-wheel, Victor type, set on concrete foundations laid on bed rock, which was uncovered about fifteen feet below the surface. These wheels discharge the waste water into a draft tube twenty-five feet long, which conveys the water through a weir to the river below.

The spider carrying the runners is bolted direct to the end of a flanged generator shaft. The runners are of a high pressure design cast in one piece.

Five generators, direct connected to each of the water-wheel units, are installed in the power-house, occupying one side of the building from end to end. Each machine is a 2000-kilowatt, revolving field, Bullock generator, 3-phase, 50-cycle, 2200-volt, 230 revolutions per minute. Two 150-kilowatt Westinghouse multipolar 125-volt direct current generators, 550 revolutions per minute, are used as exciters. These are driven independently of the main generators by two 30-inch Victor water-wheels. The governors used are all of the Lombard type, five for the main units being Type "B," and two for the exciter units of the Type "F," all operating under the same head of 263.78 feet.

The transformer room in which the bus gallery is located is built on the side of the main building away from the river. In this room are fifteen 750-kilowatt, General Electric, oil insulated, water cooled, step up transformers, 50 cycle, 2200 volts to 60,000 volts. Direct connected to these are six General Electric 60,000-volt lightning arresters.

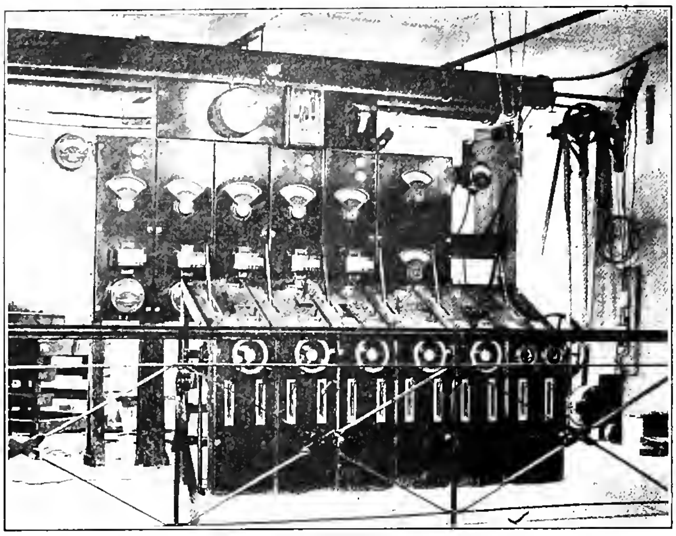
A 6-panel switchboard located in a raised gallery in a recess on one side of the power house, is outfitted with one 15,000-volt, air controlled, Kelman oil switch; twelve 60,000-volt, air controlled Kelman oil switches, and one extra 60,000-volt air controlled Kelman oil switch.

An ice plant, with a capacity of from ten to fifteen tons of ice per day, was installed in the basement of the building. This plant consists of one upright 15-horsepower ammonia compressor, manufactured by the Risdon Iron Works, driven by one 5-horsepower Type "C" induction motor.

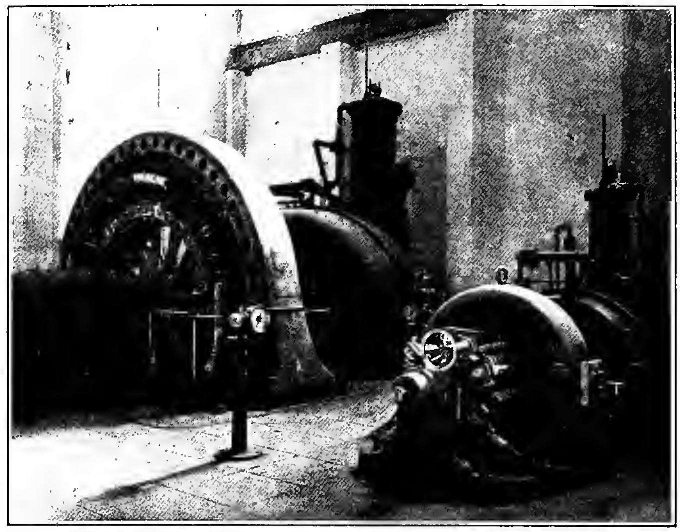
HEAD GATES AND SETTLING BASIN

The power house proper is 168 feet 3 inches long by 63 feet 10 inches wide, founded on granite bed rock, the foundation piers being anchored by iron bars driven into the solid rock. The walls are built of reinforced concrete and plastered with cement. These walls were designed especially for carrying a 30-ton electric crane which was used in the installation of the machinery.

This plant was installed the latter part of 1904 and started December 31, 1904, and has been in operation ever since, supplying power to Los Angeles, with one pumping station on the Kern River, known as the Isabella pumping station; switching stations known as Indian, 101 miles from Los Angeles; Oak, 83 miles from Los Angeles; Lake, 55 miles from Los Angeles, and Newhall, 31 miles from Los Angeles; and one substation known as the Kern substation,

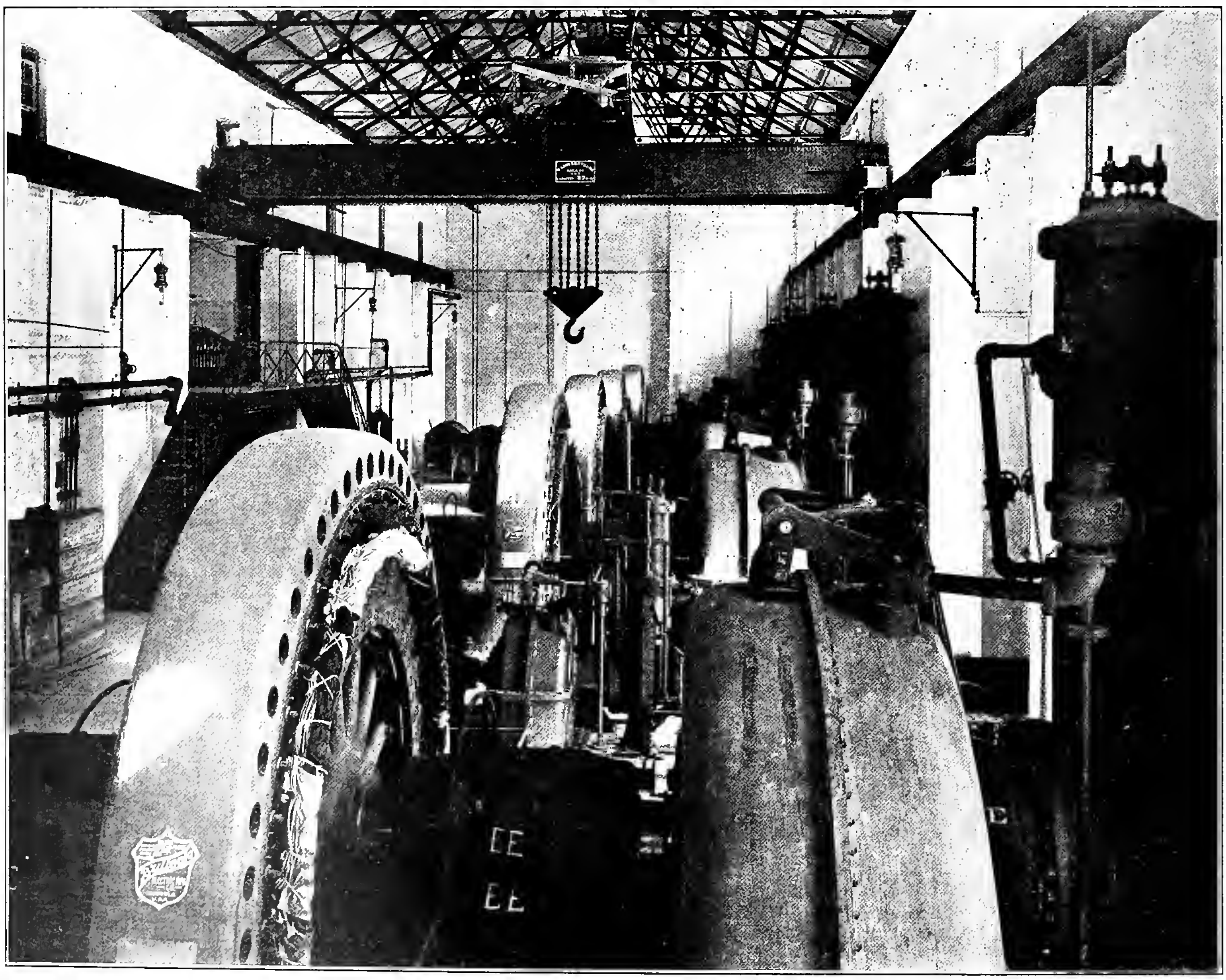


SWITCH BOARD



SINGLE-UNIT SHOWING GOVERNOR AND EXCITER WITH PRESSURE GAUGE IN FOREGROUND

located on the Mission Road. This substation is the most important one of the whole system, the lines from the plants in the south coming through there, as well as the Kern River line. A full description of this substation with accompanying cuts will appear in a later issue.



INTERIOR OF POWER HOUSE

The Isabella pumping station is supplied with two 150-kilowatt, Wagner, oil insulated, air cooled, step down transformers, 10,000 volt, 3-phase to 400 volt, 2-phase. There are four G. W. Price No. 8 pumps installed connected to four Type "C," 50-horsepower, 2-phase, Westinghouse induction motors, pumping water from the south fork of the Kern River to a canal.

Each of the switching stations consists of one 3-story concrete building with corrugated iron roofing, outfitted with four 60,000-volt, 3-pole, hand-controlled oil switches.

CAPACITY FOR SERVICE.

In the course of a masterly address at the Thomas L. Clarkson Memorial School of Technology, Mr. F. R. Hutton, president of the American Society of Mechanical Engineers, 1906-1907, contends that the education to be acquired in the modern engineering college is an admirable preparation for usefulness and opportunity in a modern community. He introduces his thesis with a strong argument on the desirability of an ideal in life higher than the mere gathering of money. He traces the gradual evolution of the criterion of the life ideal from the Epicurean through the Stoic and Nirvanian conceptions of selfish advantages, to the modern Christian ideal of service to our fellow man. This brings him to the question as to whether technical education favors the attainment of the service ideal. He recognizes two points of view of education in general:

"The one regards the educational center as a place to which the student comes to receive a discipline of mind by study and perhaps also a discipline of body by reasonable athletics. It is the purpose of this discipline to make a better man of him and to equip him mentally with a useful kit of tools in that department and give him some knowledge and skill in their use. The nature of the gymnasium apparatus used in this training process, which is the list of subjects which he shall study, is held to be of secondary consequence provided only it is perfect of its kind. That which has been proved to be perfect of its kind by the experience of the fathers and by the conditions of an aristocratic country, has a distinct presumption in its favor. At the other extreme is the view which regards the school as a fountain or wellspring of information and of facts to be imparted by skilled and expert teachers. These are to fit the graduate to deal intelligently with the problems of actual life, since he has come to know the laws which govern practical affairs and has absorbed some of the garnered experience of the skilled professors who have worked with him. Life will furnish the discipline fast enough after graduation, but gives little opportunity to learn the laws except by hard knocks. Let us, therefore, concentrate our effort on acquiring the knowledge. This is the philosophy underlying the successful effort of the correspondence school method.

"Now let us apply the test of our touchstone in the foregoing discussion to these two philosophies. It seems to me that there need be no contradiction in these two requirements, provided that each is rightly interpreted. The difficulty is to attain both ideals in a limited period. The safe middle course is so to use the study and the acquiring of physical fact and of experimental data upon matter, force and their laws, as to make such study a discipline for the mind and heart. This is the trick and the skill of the competent and successful teacher. Either extreme has its own dangers. If the student spends his four years in study of antiquities or of abstract science unrelated to the ordinary activities of life, and has pursued literature and history as culture subjects unrelated in their bearing to present-day thought, he may become polished and outwardly cultured. But the first man who tries to lick him into usable shape in active business usually finds him less available as the result of equal labor than the office boy or the apprentice who has begun at another round of the economic ladder. The graduate also from this system of education has usually been favored with the modern system of practically free election of subjects of study in his college. This possibility of doing what he likes and which appeals to him gives the young man a mistaken conception of the way things are done in the life of actual affairs; and the change from one environment to the other is so sudden and abrupt that he resents it and is unhappy or useless under it. Actual life forces him to a process which seems to him like unlearning something which he has worked to get. Both employer and employed in their discontent form an opinion unfavorable to all sorts of higher education because the one sought under comment proved to be ill-chosen for the purpose in hand.

"The great danger of the other system at the other extreme is that it should fall short of its disciplinary value because the student fails to see clearly what is his own function in the education process. It is possible that both teacher and student permit the latter to become a mere mass of absorptive tissue, taking in information and knowledge as does the dead sponge rather than by a process similar to that which is exhibited by the living tree. The lecture system of instruction by gifted experts is particularly open to this danger, since the student can be so easily lulled into a Nirvana of admiring idleness of mind, or into a state in which presence of body concurs with a practical absence of mind in the class-room. Of what use is an extensive assortment of note-books containing data, such as are gathered in our best engineers' pocketbooks, if the young man has not been trained to use his faculties or exercise his powers upon them. Worse than this is the possibility of making wrong use of valuable data and truths because still uneducated in spite of his knowledge. No more useless product of an alleged educational process is turned loose on the industrial community than a so-called educated man, whose capacity is limited to a bookful of assorted recipes for producing certain results. He may be likened to an engineering cook-book. His results taken internally by productive works give both masters and plant a figurative dyspepsia. He is underdone, but, alas, not rare.

"But when the thing is done right and the man is forced to think correctly, persistently, and to a definite and positive result, then the training in knowledge of physical law, in observation of phenomena, in constructive combination of apparatus for their study and in deduction from experiment, is, in my opinion, the most valuable there can be. There is no quality or attribute so valuable in any environment as that which we call initiative. This has been cleverly defined as the ability to do the right thing at the right time without being told. The classic or purely literary training does not foster this power of initiative. On the contrary, the perfectness of the classic models and the inevitableness of the study of the past tends to discourage and dissipate this power, unless the young man finds an outlet and a discipline for it in athletics, in the management of college journalism, and the control of musical or dramatic interest. The training in the mechanical laboratory of the technical school, on the other hand, can be directly and of purpose aimed to foster and stimulate this power. What the world calls for in its useful men is the capacity for resource to cope with conditions, which have not arisen hitherto, and to meet new obstacles and overcome them. Nature rarely gives to the same man a retentive memory for things which are past and the faculty of initiative and resource for problems of the future. The retentive memory enables a man to show well in his college class-room. He is, perhaps, the honor man or valedictorian under the old conditions. The other power is the one which makes him the class president, the football manager, and which tells later in the world of affairs. Hence, if my contentions are sound, and it be granted that usefulness in life is an ideal, then the education in applied science is that which can be so used as to fit a man best for practical usefulness in an industrial community which is built upon and is dependent upon the utilization of nature's laws.

"In all that has preceded, the service before our minds has been that which is needed in an industrial community engaged in production. The latter I have defined as the process of increasing wealth resulting from spending labor upon a raw material or a product of the soil. I think an older ideal that education should be so directed as to fit every boy to rise to be President of the United States is one which has worked harm upon our practical thinking. It is manifestly impossible within seventy years of a man's natural life that more than a very small number of the many millions of our population should ever reach this eminence.

What of the many debarred from this possibility, but who must yet be wage earners?

"In the forwarding of modern economic production it seems to me there is a demand for three kinds of ability. The education in the community should be directed to discipline and knowledge in each field of service. This recognizes the generally received analysis that under the board of directors of a manufacturing corporation will be the three departments, which may be designated as the works or productive department, the office or accounting department, and the sales department. In developing this analysis it will be plain that the largest group numerically will always be the artisan or craftsman class, who work with their hands upon the raw material either directly or through the media of tools. These tools they do not or have not designed, but they operate them and make them go. These are the workers at their respective trades; they enter them as breadwinners or producers after their childhood's contact with the public school, and either after their contact with such schools as become completed or before. For this great group it seems to me that the call is the loudest that proper provision be made that they should be specifically fitted for usefulness by the education which they receive before going to work, or which they may receive during its continuance. Their numerical importance makes industrial education for such persons a splendid opportunity for those who are gifted with vision and with wealth to render their service in this form. This education need not be deep nor decorative, but it should be broad and practical. It should be so directed that it may be an inspiration for the daily toil required of those who must be wage earners as a means of personal or family support, and who must be economically productive from boyhood. It should cover the scientific and natural laws behind the material things which they handle or control. It should reveal the intellectual and philosophic basis of their life, making it not unworthy of the divine element in man. It must make him more than a mere high-class, automatic machine. It must show the man that he is greater than his work and that this latter is a means and not an end. It must show him that possibilities of growth and achievement are his personal right, even while he appears to be contributing only as a unit in the productive process. All honor to wealth and to achievement which have seen and shall see this opportunity of service to the craftsman and shall move forward to meet the demands for industrial education among the wage-earners.

"A second class will be the organizers and directors of the craftsman, who, together with their machinery and plant, form the producing apparatus which we call a factory or mill or works. In this group will be the general managers, the draftsmen, the engineers, the superintendents and the industrial organizers. To this class belong the product turned out by the engineering schools. The young engineer in either the mechanical or electrical specialization of the day is likely to be a manufacturing engineer. They must necessarily constitute a smaller class than the preceding, but from their duties and function they will be the best paid. They are the most vitally essential under modern competitive conditions, where conformity to physical law is imperatively demanded if success is to be won without its costing too much. For these men knowledge of the crafts which they are to control is essential, but even more so a knowledge of science and its laws, covering familiarity with accepted solutions for old problems and the trend of research into new ones. For such men beside the classroom, the laboratory, the drawing-room and the school-shop will form the desired equipment.

"The third type of service is rendered in the office and in the commercial functions of the producing process. Such service is rather what is technically designed as 'personal' service rendered to the producer class rather than a direct contribution to community wealth. The compensation of such persons is a draft upon the producing cost, and hence they ought not to be too numerous. They help the easy conduct of the production process and will be fitted for their work both by special commercial training such as is offered in business colleges and correspondence schools, and by such general education as shall give them broad views, a wide range of adaptability and a capacity for suggestive recommendation in their appropriate field. The tendency, however, of modern intensive production is to reduce this class to its lowest terms.

"I put, therefore, the education of the craftsman group as the first or prime need of a service education because affecting the greatest number of the producing class. I put the education of the selected group of designers, works managers and directors of production as second only to this opportunity by reason of the less numbers affected and not by reason of any misapprehension of the importance of having the duty of these men well done.

We will be made useful and render service almost in our own despite if we engage in economic production and apply our talents and knowledge and skill to this end. But higher than this and as a means of making the best of ourselves I would specially urge that each should so labor that every study and every problem and every law is made a compulsion that we should think.

"I have condemned already the mechanical-recipe system of working out solutions by rule and without much thought. This may be used to make a well-informed man, but it will not make an educated one. The two terms 'educated' and 'well-informed' are not synonymous. I demand that the process of education should be so directed and planned that the powers of the student's own mind shall be awakened, stimulated and compelled to exert themselves. The mechanical laboratory is particularly well adapted to secure this result, because from the practical and material apparatus before the student's eye and under his hand, he can be forced to consider the connection between his mental concepts and the actual occurrence before his senses. Education should teach a man the meaning of a task as a thing to be done whether he likes it or not, and should also teach him to use his mind upon his task.

"The other thing which I would urge is that the subject-matter or content of the experimental study to be used as discipline be chosen from among the play of laws and forces, which concern the common and usual experiences of an industrial life. The purpose of this recommendation is to minimize the difference in atmosphere and condition at the educational center from that which is sure to prevail in actual life. There must be a difference, since the unit or standard of measurement in real life is the dollar, while that most suitable for the educational institution should be one which is not a variable with expediency as its exponent. In working under nature's laws in practical affairs it is as true for us as for the old writer that all things in accordance with such laws are lawful for us, but all things are not expedient. At the school the learner must have it brought home to him and clinched that nature can not be lied to nor deceived. She insists upon truth in the inward parts and must be obeyed no matter what it costs. The training in what is practically or economically possible under nature's laws and what is, therefore, expedient must be the function of life itself after leaving the school, and the best of us can only hint at such matters in the educational process. Within the limitations, however, which are set by the conditions, let the learner get in as close touch as possible with the facts and phenomena of the world of practical affairs. The technically educated man has this great advantage over his academically trained associate—that for the latter the classic languages, the civilization of dead nations and their history, the refinements of psychology and even some forms of literature and antiquarian research are without immediate relation to the functions which the man is to discharge when he becomes a worker. Never have I seen this more tersely put than in the epigram of Professor John E. Sweet of Syracuse, when he compared the usefulness of him who knew 'what to do and how to do it' with that of another 'who only knew what had been done and who did it.'"

XV. PRIME MOVERS.*

BY JOHN HARISBERGER

Prime movers that will be considered are water wheels of the impulse or action, and reaction type. The impulse type consists of a wheel or disk to the periphery of which are attached buckets. To impart rotary motion to wheel, a jet, or several jets of water, are made to impinge on the buckets and discharge from the sides. The speed of the wheel shaft depends entirely on spouting velocity of the water and diameter of wheel. This type of wheel is essentially a California development, but was first tried in Europe, then abandoned, and the Girard wheel took its place, but is again being taken up in Europe. In this country it has no competitor for service under high heads, say above 700 feet, and under certain conditions it can be used to an advantage under much lower head, when quantity of power to be developed is not large. The Pelton and the Doble wheels are of this type and are sometimes called Tangential wheels.

In the Girard wheel the buckets are so arranged that the water imparting motion passes through wheel, and can be designed so water may be applied to part or full circumference of wheel and obtain fairly high efficiency, which is of decided value when considerable power is desired under a comparatively low head, say at 600 or 700 feet, and diameter of runner must necessarily be small to secure high enough shaft speed and not use more than one runner. This wheel can be built for either inward or outward flow. It may be of interest to note that the Girard wheels have been put in practical operation under the lowest head as well as the highest that has ever been attempted, namely, 16½ inches at Geneva, Switzerland, and 3,000 feet at Vouvrey, Switzerland.

The reaction wheel, principally of the Francis inflow type, is the most popular at the present time for low head service, and it certainly has given good results in the way of reliability and efficiency. In this wheel all the channels are completely filled with water, and water applied all around circumference of runner, and when operating as a reaction wheel, which will be the case at full gate, water will be flowing under pressure from panel gates to runner, but at partial gate water will have velocity only. The load at which the wheel will run most of the time will determine position gate should be to give most efficient results, and this will determine at what position gate will be when wheel will change from operating as an action to a reaction wheel. This is a matter of design. These conditions make it permissible to have a small change in speed and not affect average efficiency. With this type of wheel, draught tube can be used, and every foot of head between head-water and tail-water be utilized. While it is true you can use a draught tube with impulse or action type of wheel by the aid of arrangement of floats and air valves in draught tube to prevent the water from rising too high, so as to interfere with the free discharge of the water from the wheel, but this arrangement is complicated and not very satisfactory.

For installation of water wheels to drive electric generators under heads up to 500 feet, the reaction turbine will give the best results, especially if a large quantity of power is to be developed. Whether the reaction turbine will give efficient results above this head has not been fully demonstrated. There must necessarily be some clearance between runner and wheel case, and a certain amount of water will leak through, which amount will increase with the pressure, and there is a possibility of dirty water increasing this clearance, which would decrease the efficiency of the wheel. The reaction turbine installed at Snoqualmie Falls under a head of 270 feet has been running continuously for over 19 months, and part of the time with very dirty water; runner, panel gates nor any part of inside of water wheel housing show any indication of wear. Practice seems to indicate that the place for the impulse type of wheel is about 800 feet head and over where it gives excellent results. The impulse wheel has been used rather promiscuously under many different heads. It being very often chosen for its simplicity and low cost, efficiency is given little consideration. I believe that as high an efficiency in the use of water has never been attained with an impulse wheel under a head not over 500 feet as could have been obtained by the use of a reaction turbine in its place, with present state of perfection of the turbine. The impulse wheel being a free deviation or free discharge wheel, necessitates setting it high enough above tail-water so that in no event back-water can rise high enough to interfere with the free discharge of the water from wheel, for if it did it would operate very unsatisfactorily, and output of wheel be much reduced. Setting the wheel above tail-water causes a loss of head, varying in different installations from 5 to 25 feet, while as mentioned before, with a reaction turbine, every inch of head can be utilized from intake to tail race with the use of a draught tube. For very small units at low head the impulse wheel may at times be desirable on account of its simplicity and low cost, but where large units are to be used the advantage shown by the reaction turbine is quite pronounced. The present tendency is to install as large units as conditions will permit. What will determine this, is the amount of power to be developed. I would install for a 5,000 horsepower plant, 3 units; over 5,000 to 20,000 horsepower plant, 5 units; over 20,000 to 50,000 horsepower plant, 7 units; over 50,000 to 100,000 horsepower plant, 10 units.

Experience has shown that this proportion is good practice, the larger the total of the plant the larger individual unit permissible. By total of plant is not meant that units must be in one building, but may be in several buildings, miles apart, and arranged so all units can be run in multiple electrically, and each unit carry load to its full capacity. As to speed of water wheels, I would have this as high as I could get a reliable water wheel manufacturer to build an efficient wheel, so as to keep the cost of generator down at not excessive cost of water wheel. Steam turbine practice has shown that the limit of speed for electric generators is far beyond what can be reached with water wheels. We will take for instance the condition of a development of 20,000 horsepower in 5 units or 4,000 horsepower units under 350-foot head. If impulse wheels are used, the first thing we will lose is at least 10 feet in head on account of it being necessary to set the wheel some distance above tail-water. This is almost 3 per cent or 600 horsepower, which amounts to $15,000 per year, power at $25 per horsepower. The speed of the 4,000-horsepower units should be at least 500 revolutions per minute; 600 would be quite practical for a reaction turbine as well as generators, but unsatisfactory for an impulse wheel under 350-foot head. The most efficient speed of an impulse wheel is 45 to 46 per cent of the spouting velocity of the water, and the spouting velocity at 350-foot head is a little over 150 feet per second. Consequently an impulse wheel to run 500 revolutions per minute under 350-foot head should be about 32 inches in diameter at center of buckets. Size of jet for wheel should not be larger than 3 inches in diameter, and more than one jet per wheel on wheels of small diameter have never given efficient results, especially when running on horizontal shafts. One 3-inch jet on a 32-inch wheel, under 350-foot head will develop about 150 horsepower. To develop 4,000 horsepower would necessitate a string of 27 wheels on shaft connected to one generator. This shows the impracticability of impulse wheels for low heads and high speeds where large amount of power is to be develepd.

Efficiency, reliability, and speed regulation of the water wheel are the most important features of the water wheel

*Lecture to the students in Electrical Engineering, University of Washington, Seattle.

installation. Design and construction of hydraulic installation from intake end of pressure pipe to tail race affect these features, so they should be given consideration at the proper time.

It is good practice to have a separate pressure pipe for each unit. Speed regulation of wheels operating under low head is generally obtained by throttling the water, which naturally causes a variation of velocity of the water in pressure pipe, so that when more than one wheel draws water from same pressure pipe, a change of load on one wheel will affect the speed of the other. Ordinarily a good governor will take care of this speed variation, but it is not the best arrangement for perfect regulation. It is necessary to occasionally inspect and repair any apparatus that is under strain, and accidents are possible to happen. So it should not be necessary to shut down a large proportion of the plant at one time. An ideal condition for water power plants is to have a unity load factor, as it costs just as much to run a water power plant at partial load as at full load.

Sometimes conditions are such that it is necessary to have a long pressure pipe, when it may be desirable to have more than one unit receiving water from the same pipe when water wheel gates should be arranged so they will not close at the same time, nor in too short a time, thus decreasing the possibility of dangerous rise of water pressure.

The highest effective head should be secured with shortest pressure pipe possible, and pressure pipe be laid in as straight a line as possible, as curves cause friction, and friction causes loss of head.

Errors in calculation as to size and design of pressure pipe have been the cause of more unsatisfactory operation of water wheels as to efficiency, especially of the impulse or action type, than any other cause. Head is first obtained by getting the difference of elevation of head-water and tail-water, and often water wheels are built for this head, which may be called the hydrostatic head, and neglecting the loss of head caused by curves in pressure pipe, as well as the friction losses in straight pipe itself, which is likely to amount to several feet, especially if design as to size of pipe has not been liberal. Loss may also occur from improper design of nozzle tip, but this will concern the water wheel builder only, as tip should be included with water wheel, and the combined efficiency be guaranteed by the manufacturer.

If the wheel is designed for hydrostatic head and it is found that the effective head is less, it will not run at 45 per cent of the spouting velocity, therefore, not at its most efficient speed. This is the case when the wheel is to be connected direct to an alternating current generator, as the frequency of the generator fixes the speed. With reaction turbines a slight change in head is not so serious, as it will change the position of the gate where the wheel begins to operate from an action to reaction wheel, and still maintain a good average efficiency. Short pressure pipes are desirable for impulse wheels, where no attempt is made to economize in the use of water; speed regulation being obtained by deflecting variable amounts of water on the buckets, thus having constant velocity in pressure pipe. For reaction turbine speed regulation is generally obtained by throttling the water, thus changing the velocity in pressure pipe. This makes possible an excessive rise of pressure, developing conditions which are detrimental to good speed regulation. The longer the pressure pipe the more serious this is. The column of water in motion between head gate and wheel of reaction turbine running at Snoqualmie Falls is 300 feet. This makes 3,600 cubic inches of water, or 126 pounds, as the weight of column per square inch, 126 pounds x 12, average velocity of water per second=1,512 pounds, apparent pressure on gate of wheel if closed in one second. Waves of compression in water travel about 4,700 feet per second, therefore, $\frac{4700}{300+300}=7.8+$ times that the wave travels from wheel to intake in one second. 1,512—120 hydrostatic pressure=1,392. 1,392÷7.8=180 pounds actual rise of pressure at wheel if gate closed in one second 180+120=300 pounds pressure bottom of pressure pipe and wheel case. The time necessary for closing gate of this installation to prevent any noticeable rise of pressure is 7 seconds. While these calculations are not absolutely accurate they are simple and by actual test have proven close enough for practical purposes when expansion and friction in pressure pipe is not considered.

To overcome this rise at low heads, there are two remedies: one is the use of relief valves, the other a stand pipe. The rise of pressure caused by impeding the flow of water in pressure pipes will naturally interfere with speed regulation, so some method must be employed to prevent this rise, either a relief valve or a stand pipe, or have governor close gate slow enough so there will be no rise, and the longer the pressure pipe the slower this must be. While the gate is closing there should be some means to take care of the excessive change of speed; this is generally done with fly wheel capacity of the rotating part of the unit. The water wheel runner does not amount to much for this, so most of the weight must be put in the revolving part of the generator. It takes time to accelerate mass, and takes time to retard it when in motion. The governor is adjusted as to reference to this time, so as to open the gate before all the stored energy is expended in revolving element, and when load drops off, gate must be closed before excessive amount of energy can be stored in rotating element. The more fly wheel capacity the longer this time can be. These conditions should be adjusted so that speed of unit will not rise more than 10 per cent when all load is taken off instantly when running at full load. This is a liberal range for the average installation. The larger the capacity of plant the easier it is to maintain good speed regulation as the probable amount in change of load will be smaller in proportion to total of plant and connected load.

CIVIL SERVICE EXAMINATIONS.

The United States Civil Service Commission announces an examination on July 17, 18, 19, 1907, to secure eligibles from which to make certification to fill a vacancy in the position of electrical engineer and draftsman in the Supervising Architect's Office, at $1,200 per annum, and several vacancies in this position as they may occur during the period of eligibility, at salaries ranging from $1,200 to $1,600 per annum. As no eligibles were secured as the result of the examination held in March for this position, qualified persons are urged to enter this examination.

Examinations will be held on July 10-11, 1907, to establish registers from which to make certification to fill vacancies as they may occur in the positions of topographic draftsman. The salary for the position of topographic draftsman ranges from $1,000 to $1,500 per annum, and for copyist topographic draftsman from $900 to $1,500 per annum. As the result of the examination for topographic draftsman, a vacancy at $1,000 per annum in the Hydrographic Office of the Navy Department will be filled. As an insufficient number of eligibles to meet the needs of the service was secured as the result of the examinations held on March 13-14, 1907, qualified persons are urged to enter these examinations.

ELECTROLYTIC CORROSION.

In nearly all single-trolley roads the trolley wire is connected to the positive pole of the dynamo, and the rails are connected to the negative pole. In cheaply constructed roads the connection to the rails is only made at the power station, and the rails are, therefore, expected to serve as the return conductor for all current. In order to make the rails a continuous conductor they are bonded at their joints, ordinarily with copper wire.

The rails are in contact with the ground for their entire length, and as the street soil is a conductor, part of the return current must shunt through the ground in accordance with the law of divided circuits. This current, which as it were, leaks from the rails through the ground, is called stray current. Neglecting any slight counter electromotive force, the amount of stray current varies directly with the potential difference in the rails and inversely with the resistance between the point at which the stray current leaves the rails and the point at which it again enters the return conductor. The stray currents would disappear, then, either with zero potential differences in the rails, or, with an infinite resistance to their path, two conditions which are clearly impossible with a single-trolley electric road, and, therefore, stray currents are always produced by such roads.

If the ground through which the stray currents pass contains metals such as water pipes and gas pipes, which have a high conductivity, these currents will largely pass through such metals. In general, in districts distant from the power house the stray currents flow through the intervening soil from the rails to the pipes; these districts are, therefore, called negative districts, and the pipes in them negative pipes. In the district surrounding the power house the stray currents flow from the pipes through the intervening soil to the rails; these latter districts are, therefore, called positive districts, and the pipes in them positive pipes. Between these two districts the stray current flows from rails to pipes or from pipes to rails, depending upon the distribution of cars, etc. These intermediate districts are sometimes called neutral districts.

Since every electric circuit must be completely closed, all current which leaves the plus terminal of the dynamo must return to the negative terminal. For this reason all current which escapes from the rails in the negative district and reaches the pipes, must again leave the pipes in the positive district in order to return to the negative pole of the dynamo. The electric current is in this respect very different from gas or water, which latter can leak from a pipe and become diffused through the ground.

With the stray currents in the ground and on the pipes we have, then, the conditions of an electrolytic cell, the pipes and rails being the electrodes, and the dissolved salts in the soil, the electrolyte. In the negative district the current flows from the rails through the soil to the pipes, and the rails (anodes) are corroded, while the pipes (cathodes) are not corroded. The corrosion of the rails does not concern the pipe-owning companies, and they have considered these negative districts as safe districts. In the positive district the current flows from the pipes to the soil and the pipes (anodes) are corroded by the current. For this reason the positive district has been called the danger district.

The reason for connecting the negative, rather than the positive, pole to the rails was to concentrate the positive district within the region surrounding the power house; it was hoped in this way to restrict the pipes endangered by electrolysis to this definite and comparatively small region, so that they could be watched and remedies applied. It has been found, however, that there are many points in the negative and intermediate districts, for instance, at joints, where current may leave a pipe and produce electrolysis.

In most large, single-trolley systems the rails are connected to the negative busbars by return feeders at a number of places besides directly at the power station. At each point of connection of such a return feeder to the rails a positive region is established, and some stray currents will leave the pipes in this region to return to the rails near such points.

The danger region of a piping system is, in fact, by no means confined to the so-called positive districts, but at every point where current leaves a pipe to pass into wet soil, electrolytic corrosion must take place. An iron pipe is ordinarily not in uniform contact with the surrounding soil, owing to high resistance oxide coating, etc., so that the current leaves in spots where there is good contact with the soil. The result of this is that the corrosive action is concentrated at these spots so that holes or pittings are produced by the corrosion.

One ampere-year will corrode 20 pounds of iron or 74 pounds of lead. Secondary chemical reactions may, however, greatly increase this amount of corrosion. It must also be understood that this 20 or 74 pounds of corrosion occurs at every point at which the current leaves the pipe for wet ground, and that the same ampere of stray current can leave and again return to a pipe any number of times in its path, depending upon the electrical conditions; so that any number of times 20 or 74 pounds of corrosion may be produced by a single ampere of stray current in one year.

The published results of some laboratory tests with alternating currents seem to indicate that these may also produce electrolysis, the extent of which is probably a small fraction of that produced by an equal direct current. Alternating currents would, however, corrode both electrodes. Electric trolley roads have only very recently begun to use alternating currents, and, so far, no practical experience has been furnished from which it can be concluded whether electrolytic corrosion is practically negligible or not. It is, therefore, not safe to assume, as some writers have done, that the substitution of alternating for direct currents on single-trolley roads would eliminate electrolytic troubles.

Electrolytic surveys which consist only of voltmeter readings are not sufficient to determine the existence and extent of electrolytic corrosion. Direction and strength of current flow in various parts of the system are required in addition to the voltage readings.—From a paper prepared by Prof. A. F. Ganz for the Committee on Electrolysis and submitted to the American Gas Institute.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

Seattle Branch.

The Seattle Branch, A. I. E. E., held its annual convention at Spokane this year. Saturday, June 15, 1907, was spent in examining the single phase railway system of the Spokane Inland Electric Railway. J. B. Ingersoll read a paper on the "Single Phase System of Railways."

Mexico City, May 22.—The Mexican government has granted the application of the Batopilas Mining Company of Batopilas, State of Chihuahua, for a concession to install a hydro-electric plant at Los Algodones, on the Batopilas River. A transmission line will be built from the plant to the mines and smelter of the company at Batopilas.

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EASTERN AGENCIES
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Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," with which is incorporated "The Engineers', Architects' and Builders' News."
Entered as second-class matter at the San Francisco Post Office, August 15, 1899.
Entered as "The Electrical Journal," July, 1895.
Entry changed to "The Journal of Electricity," September, 1895.

VOL. XVIII JUNE 22, 1907 No. 25

EDITORIAL.

TRADE UNIONISM AND THE OPEN SHOP

For the first time in many years the theory and practice of the "Open Shop" is being discussed in San Francisco, and in this very fact, although the prejudice against such industrial freedom is deep rooted and passionate, may be discovered at least a grain of encouragement and hope.

It is obvious that the firm stand taken by Mr. Patrick Calhoun, president of the United Railroads, has revealed to a skeptical populace that it is not only possible, but even popular, to operate one of San Francisco's largest industries without surrendering to the demands and dictation of a Labor Union. Until only a few weeks ago the average San Franciscan was so convinced of the omnipotence of Trade Unionism in this city that he would have laid long odds against Mr. Calhoun's ultimate victory. The fact that it has been possible in San Francisco to resume general service with cars manned by non-union motormen and conductors has been a distinct eye-opener to most of us. What fair-minded man can deny that this is only as it should be? The right of the United Railroads to employ either members of the Carmen's Union or non-union men, as it prefers, can not be questioned. It is an established right under the law and Constitution. Similarly, of course, non-union platform men have a legal and constitutional right to work for the United Railroads without interference from any organized body. Nevertheless these rights have been challenged, not only in the recent carmen's strike, but in every industrial trouble that has beset San Francisco during the last decade. Freeborn American citizens, preferring not to surrender their individual liberty to the custody of any union, have been prevented by all sorts of intimidation and violence from working as teamsters, as longshoremen, and in numerous other trades. In fact, so general and so passionate has been San Francisco's devotion to the principles and practices of Trade Unionism that not one man in ten was to be found who truly appreciated the American principle of individual liberty, and who did not predict that this city was irrevocably committed to a labor monopoly of Trade Unionists.

Two men, Patrick Calhoun of the United Railroads and Henry T. Scott of the Pacific Telephone & Telegraph Company, have demonstrated conclusively that two of the great public utilities in San Frnacisco can be, and in future will be, operated without dependence on any union. Both of these men, naturally enough, have aroused savage animosities in the breasts of Trade Unionists and their innumerable sympathizers, but both stand firm. And the better sense of this community will award to them due gratitude, first for having saved this community from intolerable inconveniences and having alleviated the paralysis of trade, and secondly for becoming champions of an indubitable American principle.

Neither of these men had shown any prejudice against Trade Unionism. On the contrary, they had been perfectly contented to deal with unions as long as their methods seemed to them justifiable and their demands commensurate with the services their members performed. Mr. Calhoun, indeed, as the record proves, showed a remarkably liberal spirit of toleration in his various and vexatious negotiations with the late Carmen's Union. He frequently has expressed a preference for dealing with a union. And such preference is natural with those who employ great numbers of workers, since employers find it more convenient to deal with their employees by a representative process.

The Carmen's Union divorced itself from public sympathy by violating its own general laws and by the tactics of hoodlumism with which this, as all other strikes, has been disgraced.

It is not simply Mr. Calhoun or Mr. Scott who

has broken the Carmen's strike or the Telephone Operators' strike. Their most masterful efforts would have been abortive had not the public stood behind them and supported them, and herein should lie the greatest lesson, not only for Labor Unions but for the third party to all such industrial strikes—the general public. For it is public opinion, and public opinion alone, which ever must render the final verdict in such industrial disputes. The people do not yet recognize either their duty or their strength in this regard. They are actually the arbitrators.

One fallacy concerning the theory and practice of the "Open Shop" should be removed. It is the fear that the "Open Shop" is designed to crush Trade Unionism. The "Open Shop" aims to do nothing of the kind. Instead of crushing Labor Unions it will correct their evils and strengthen their benefits. The "Open Shop" merely insists on the natural, constitutional and inviolable right of the individual to buy or sell labor as it seems best to him under the law. The great complaint against Labor Unions has been that they so frequently depart from their own expressed principles in assuming to dictate to the employer the conduct of his business. Their refusal to grant to non-union workers the constitutional right of free employment and their failure to assume the responsibilities of incorporation, so as to make their contracts tenable before the law, are also justly held against them. Those unions which abide by their birthright and by honest and just principles are respected by every good citizen, and such need have no fear from any establishment of the "Open Shop" principle in San Francisco.

TRADE CATALOGUES.

Bulletin No. 1513, from the air-brake department of Allis-Chalmers Co., Milwaukee, Wis., describes and illustrates the Christensen Portable Air Compressor, which consists of a motor-driven compressor, automatic governor, switch and fuse, reservoir, air gauge, pipe, hose and fitting, all mounted on a four-wheel platform trick.

The June Bulletin of the Ohio Brass Company, Mansfield, Ohio, contains a number of interesting articles on overhead trolley construction.

Leaflet No. 2031A, from the Allis-Chalmers Co., Milwaukee, Wis., illustrates the American Blower Co.'s vertical self-oiling engine, direct connected to electric generator.

PERSONAL.

F. F. Hall has joined the engineering staff of the Woodruff Construction Co., of San Francisco.

G. W. Pulver, district manager of Allis-Chalmers Co., at Seattle, Wash., has moved his office to 115 Jackson Street.

H. M. Byllesby & Co. have been retained as consulting and supervising engineers by the Mobile and Ohio Railroad Co., for the rehabilitation and electrification of their general repair shops at Whistler, Alabama.

BENEFITS OF EDUCATION.

Ambassador James D. Bryce delivered the convocation oration at the University of Chicago. His subject was, "What University Instruction May Do to Provide Intellectual Pleasures for Later Life." He opened his address by commenting upon the fact that production and transportation all over the world had been transformed by science, and he said that the effect of science was also strongly felt in education. Sixty years ago, he said, science was not given a prominent part in the curriculum of schools and universities, and now it was trying to relegate the study of language and literature to a secondary place. In some parts of the world, he said, it was becoming necessary to insist upon the importance of the human as opposed to the natural or scientific subjects. He continued:

"I ask you to join with me in considering the value and helpfulness to the individual man of scientific studies and of literary studies, respectively, not for success in any occupation or profession, nor for any other gainful purpose, but for what may be called the enjoyment of life after university education has ended.

"All education has two sides. It is meant to impart the knowledge, the skill, the habits of diligence and concentration which are needed to insure practical success. It is also meant to form the character, to implant taste, to cultivate the imagination and the emotions, to prepare a man to enjoy those delights which belong to hours of leisure and to the inner life which goes on or ought to go on all the time within his own heart.

"Every one of us ought to have a second or inner life over and above that life which he leads among others for the purpose of his avocation, be it to gain money or power or fame, or be it to serve his country or his neighbors. He ought to have some pursuit or taste to which he can turn from the daily routine. Whatever the taste or pursuit may be, whether of a higher or common type, it is good for him, but, of course, the more wholesome and elevating the taste or pursuit is, so much the better for him."

The speaker then asked his hearers to consider the question of what could be done by instruction in natural science and what instruction in the human literary pursuits could do to instill such tastes or suggest pursuits. The human subjects, he declared, were best fitted to nourish and illumine the inner or personal life. In conclusion Bryce said:

"The practical lessons I would deduce are that the ardor with which the study of the physical sciences is now pursued for practical purposes must not make us forget that education has to do a great deal more than to turn out a man to succeed in business. In the second place, students must remember that in the study of language and history they must beware of giving exclusive attention to the technical philological work and to purely critical inquiries. Nowhere in the world does there seem to be so large a proportion of the people that receive a university education as here in America. The effects of this will doubtless be felt in the next generation. Let us hope that they will be felt not only in the complete equipment of your citizens for public life and in the warmer zeal for civic progress, but also in a true perception of the essential elements of happiness, a larger capacity for enjoying those simple pleasures which the cultivation of taste and imagination opens to us all."

LOCAL STOCKS AND BONDS

Furnished by Courtesy San Francisco Stock and Bond Exchange.

Outstanding	INTEREST	MISCELLANEOUS BONDS.	JUNE 14		JUNE 15		JUNE 17		JUNE 18		JUNE 19		JUNE 20	
			Bid	Asked	Bid	Asked	Bid	Asked	Bid	Asked	Bid	Asked	Bid	Asked
1,532,000	F & A	Associated Oil Co. 5%		81		81		81		81		81		81
2,250,000	M & S	Bay Counties Power Co. 5%		100		100		100		100		100		100
1,000,000	F & A	Cal. Central Gas & El. 5%		103		103		103		103		103		103
9,600,000	M & S	Cal. Gas & El. Gen. M. & C. T. 5%		80		80		80		79	77	79		79
900,000	J & J	California St. Cable Co. 5%	100			105		105		105		105	100	105
2,000,000	J & J	Contra Costa Water Co. 5%	100	102½	100	102½	100	102½	100	102½	100	102½	100	102½
1,000,000	J & J	do do Gen. Mtg. 5%		97½		97½		97½		97½		97½		97½
623,000	F M A N	Edison Light & Power 6%		112½		115		115		115		115		115
650,000	M & S	Ferries & Cliff Ho. Ry. 6%	103½		103½		103½		103½		103		103	
671,000	A & O	Geary St. Ry. 5%	52		52		52		52		52		52	
610,000	M & N	Honolulu R. T. & L. Co. 6%	105⅜		105⅜		105⅜		105⅜		105⅜		98	
300,000	A & O	Lake Tahoe Ry. & T. Co. 5%												
500,000	J & J	Los Angeles Elec. Co. 5%	100		100		100		100		100		100	
1,300,000	J & J	Los Angeles Gas & Elec. Co. 5%		101½		101½		101½		101½		101½		101½
5,000,000	A & O	Los Angeles Ry. 5%		109		109	105	108	105½	108	106	108	106	108
1,000,000	A & O	Los Angeles Lighting Gd. 5%		105		105		105		105		105		105
1,500,000	A & O	Los Angeles Pac. R. R., 1st Con. Mtg. 5%	102¼	103½	102¾	103½	102¾	103½	102½	103½	102½	103½	102½	103½
3,030,000	M & S	L. A. Pac. R. R. of Cal. 5%		103		103		103		103		103		102½
3,000,000	J & J	Market Street Cable 6%	107		107		107		107		107		107	
5,141,000	M & S	do Ry., 1st Cons. Mtg. 5%		105		105		105		104		104½		103
100,000	A & O	Mill Valley & Mt. Tamalpais S.Ry. 5%	103		103		103		103		103		103	
4,751,000	A & O	Northern Ry. Co. of (Cal.) 5%	110½	111½	110½	112	110½	111½	110¼	111½	111	112	111	112
1,498,000	J & J	North Pacific Coast R. R. 5%	100		100¼	101½	100		100¼	102	100¼	102	100¼	
1,074,000	J & D	Northern Cal. Railway 5%		107½		107		106		106		105		105
980,000	J & D	Northern Cal. Power Co. 5%		100		100		100		100		100		100
6,000,000	A & O	Northern Electric Co. 5%		97½		97½		97½		97½		97½		97½
1,000,000	M & S	Oakland Gas Light and H. 5%	102½		102½	106	102½		102½	106	102½	106	102½	106
1,374,000	J & J	Oakland Transit Co. 6%	111	112	111	112	110½		110½		111¼		111	
1,600,000	J & J	Oakland Transit 5%	102		102½		102		102		103		102½	
1,326,000	J & J	Oakland Transit Con. 5%	102	103	101½	103	101½	102½	102	102¾	102	102½	101½	102½
7,000,000	J & J	Oakland Traction Con. 5%	100		100		100		100			100		101½
1,500,000	J & J	Oakland Water Co. gtd. 5%		99		99		99		99		99		99
2,000,000	A & O	Omnibus Cable Ry. 6%	112	118	112	118	112	118	112	118	112	118	112	118
1,149,000	S D M J	Pacific Gas Imp. 4%		95		95		95		95		95		95
8,494,000	J & J	Pacific Electric Ry. Co. 5%	102¼		102¼		102¼		102¼		102	103	102	102¼
4,491,000	J & J	Pacific Light & Power Co. 5%		100		100		100		100		100		100
3,000,000	J & J	Pacific Tel. & Tel. Co. 5%		104		104		104		104		104		104
350,000	J & J	Park & Cliff House Ry. 6%												
250,000	J & J	Park & Ocean R. R. 6%		112½		112½		112½		112½		112½		112½
700,000	M & S	Powell Street Railway 6%		107½		107½		107½		107½		107½		107½
2,500,000	M & N	Sacramento Elec. Gas & Ry. 5%	98		98½		98½		98½		98½			100
6,000,000	A & O	S. F. & S. J. Valley Ry. 5%	110½		110½		110½		110½		111½		111	
3,000,000	J & J	S. F., Oak. & San Jose Ry. 5%		105	103½		103	105	103	105	102	105	104	
1,500,000	J & J	do do 2d Mtg. 5%		101		101		101		101		101		101
1,500,000	A & O	S. J. & S. Clara Co. R. R. 4½%		91		91		91		91		91		91
642,000	A & O	Sierra Ry. of Cal. 6%	108½		108½		108½		108½		108½		108½	
6,000,000	J & J	S. P. R. R. of Arizona 6% (1909)	103⅜				103½	104	103½	104	103½	104	103½	
4,000,000	J & J	do do do (1910)	104		104		104		104		104	105	104	
5,116,000	A & O	S. P. R. R. of Cal. 6% (1912)		110		110		110		110		110		110
4,127,500	M & N	S. P. R. R. of. Cal., 1st c. gtd. 5%	113⅝	116⅞	113⅝	116⅞	113⅝	116⅞	113⅝	116⅞	113⅝	116⅞	113⅝	116⅞
3,533,000	A & O	S. P. Branch Ry. of Cal., 6%	123	126⅛	123	126	123	126	123	126	123½		123¾	126½
81,178,000	J & J	S. P. R. R. Co., 1st Ref'd'g. 4%	90½	91	90½	91	90½		90¼	90⅞	90⅜	91	90	90½
17,500,000	J & D	Spring Valley Water Co. Gen. Mtg. 4%		86		86		86		85½		85½		85½
300,000	M & S	Stockton Gas & Elec. Co. 6%	100		100		100		100		100		100	
2,000,000	J & J	United Gas & Elec. Co. 5%												
20,000,000	A & O	United R. R. of S. F. 4%	69½	70	69½	70	69¾	70¼	69⅜	70	69	69¾	68½	69¾
2,500,000	M & N	Valleys Counties Power Co. 5%		100		100		100		100		100		100
		Water Stocks.												
		Contra Costa		62		62		62		62		62		62
6,000	Quarterly	Marin County		62		62		62		62		62		62
280,000		Spring Valley Water Co.	19¾	20	19¾	20	19⅝	20	19¾	20	19¾		19¾	20
		Gas and Electric Stocks.												
37,500		Martel Power Co.												
9,340		Mutual Electric Light Co. (Ctfs.)	4½		4½		4½		4½		4½		4½	
37,336		do (Extended Ctfs.)	12	13	12	13		13¼	12½	13	12½	13	12½	13
40,000	Monthly	Pacific Lighting Co.	65	75	65	75	65		65		65		65	
12,000		Stockton Gas & Elec. Co.	52		52		52		52		52		52	
		Street Railroad Stocks.												
10,000		California		142½		142½		142½		142½		135		135
10,000		Geary		41		41		41		41		41		41
10,000		Presidio		25		25		25		25		25		25
	Semi-an.	Associated Oil Co.	34½	35	34	34¾	33¾	34	33½	34	33½	34	33½	33⅝
1,625	Quarterly	Mill Valley & Mt. Tamalpais S. Ry.		110		110		110		110		110		110
180,000	Quarterly	Pac. Tel. & Tel. Co. (Pfd.)		97½		97½		97½		97½		95		95
180,000		Pac. Tel. & Tel. Co. (Common)	7½		7½		7½		7½		7½		7½	15

Unlisted Securities

Outstanding	Interest	Security	June 14 Bid	June 14 Asked	June 15 Bid	June 15 Asked	June 17 Bid	June 17 Asked	June 18 Bid	June 18 Asked	June 19 Bid	June 19 Asked	June 20 Bid	June 20 Asked
750,000	A & O	Bay Counties Power Co. 6%		103		103		103		103		103		103
745,000	M & S	Blue Lakes Water Co. 6%												
2,000,000	A & O	California Northwestern Ry. 5%		108		108		108		108		108		108
160,000	J A J O	Marin County Water 5%		100		100		100		100		100		100
600,000	J & J	Risdon Iron Works 5%		100		100		100		100		100		100
500,000	M & S	S. F. Dry Dock 5%		109		109		109		109		109		109
8,000,000	M & N	S. F. Gas & Electric 4½%		95		95		95		95		95		95
3,926,000	J & J	S. F. & North Pacific Ry. 5%	103	104	103				102¾		103	105	103	
5,500,000	J & J	South Pacific Coast Ry. 4%		95		95		95		95		95		95
		Standard Electric Co. 5%		92½		92½		92½		92½		92½		92½
		do do Gtd. 5%		95		95		95		95		95		95
750,000	J & J	Sunset Tel. & Tel. Co. 6%												
2,250,000	A & O	Sunset Tel. & Tel. Co. 5%		105¼		105¼		105¼		105¼		105¼		105¼
1,000,000	M & N	Sutter Street Railway 5%		105		105		105		105		105		105
		Stocks.												
50,000	Monthly	Gas Consumers' Association												
100,000	Monthly	Northern Cal. Power Co.	21	22	21	21½	20½	21	20½		20½	21	21	21½
		Pac. Gas & Elec. (Pfd.)		50		50		50		50		50		50
		Santa Cruz Port. Cement	56	60	57		57		57			60		57½
		Standard Port. Cement (New)		65		65		65		65		65		65
50,000	Monthly	Truckee Electric Co.	15	16	15	16		16	15	16		16	15	16

Electrical Construction for the Architect and Engineer

DEFINITIONS OF SOME UNITS USED IN ELECTRICAL ILLUMINATING ENGINEERING.*

The ohm or international ohm, is the unit now universally used by which is here meant the International Ohm of the International Electric Congress, held in 1893, in Chicago. It is the resistance of a column of mercury at 0 degree C. 106.3 centimeters long, weighing 14.4521 grammes, and having a uniform cross section.

One ohm has such resistance that if one volt of electromotive force were applied to it, one ampere of current would exist in it. Ohms equal volts divided by amperes.

The volt, or International Volt, of the International Congress, is that electro-motive force which will maintain one international ampere through one international ohm. The Clark standard cell at 15 degrees C. gives 1.43 volts.

Volts equal amperes times ohms.

The Ampere, or International Ampere of the International Congress, is one-tenth of the C. G. S. electro magnetic unit of current. For practical purposes it was defined by the Congress as the current, which, under special conditions, deposits .001118 grammes of silver per second, but better defined as the amount of current which will exist in a resistance of one ohm when one volt of electro motor force is applied to that resistance.

Amperes equal volts divided by ohms.

The watt is the unit of power, defined by the International Congress of 1893, in Chicago, as equal to 108 C. G. S. units of power (erg per second). One watt = one volt x one ampere in direct current and non-inductive alternating current circuits. Watts = amperes x volts x power factor in inductive alternating current circuits.

One kilowatt = 1,000 watts.

One watt hour = one watt for one hour.

One kilowatt hour =1,000 watts for one hour.

One horsepower = 33,000 foot pounds per minute.

One horsepower =746 watts.

One hefner is the light produced from an amyl acetate lamp of fixed dimensions and height of flame. It is the accepted unit of intensity of light.

Candlepower is the intensity of light from one British standard candle, which is a candle of specified manufacture. One hefner = .88 English candle.

Mean spherical cândlepower is the average intensity of illumination delivered from a source of light considering the total sphere of light.

Mean spherical candlepower is the average intensity of illumination delivered from one source of light considering either the upper or lower hemisphere.

Spherical candlepower is the total illumination delivered from a source throughout the total sphere of light.

Lumen is the unit of flux of light, and is the flux of light in a beam of one unit solid angle (one which subtends a square meter at a radius of one meter) in which the intensity is one hefner. One lumen = solid angle hefner.

Lux is the illumination produced on a surface by one hefner at a distance of one meter.

Lumen per watt express the efficiency of the light delivered to the energy consumed.

Lux per lumen is the ratio or efficiency of the illumination received to the illumination delivered, and obviously applies to placement of the source of light with respect to the surface to be illuminated.

Lux per watt is the ratio or efficiency of illumination received to the energy consumed.

Candle foot is the illumination on a surface, one foot from a one-candle source.

Candles per watt is the ratio or efficiency of illumination delivered to energy consumed.

Candle feet per candle is the ratio or efficiency of illumination received to the illumination delivered, and obviously applies to the placement of the source with respect to the surface to be illuminated.

Candle feet per watt is the ratio or efficiency of the illumination received to the consumption of energy.

Power depending upon coal is what is needed finally for illumination.

The horsepower, as I have stated here, equals 33,000 foot pounds per minute, i. e., it is equivalent to the work done in raising one pound 33,000 feet in one minute, or 33,000 pounds one foot in one minute. Notice that it is the product of distance, force and time. The horsepower is the English unit of power. The "watt" is the C. G. S. unit, which means centimeter gramme, second unit, and one horsepower is equal to 746 watts.

*Paper read before the Philadelphia Section of the Illuminating Engineering Society, by W. A. Evans.

APPROVED ELECTRICAL DEVICES.

This department from time to time will contain an illustrated description of all fittings approved by the Underwriters' National Electric Association.

CABINETS.

G. E. metal, with wooden doors and trims. Approved May 16, 1907. Manufactured by

General Electric Co., Schenectady, N. Y.

CONDUIT BOXES.

Sprague, Cat. Nos. 6234 and 6235 for armored cable. Cat. No. 6200 with canopy covers. Approved May 28, 1907. Manufactured by

Sprague Electric Co., New York, N. Y.

CUTOUT BASES, CARTRIDGE FUSE.

"Union"—all capacities, 250 and 600 V. Approved May 25, 1907. Manufactured by

The Chicago Fuse Wire and Mfg. Co., Chicago, Ill.

FIXTURES.

Flexilite. An adjustable desk or bracket fixture. Approved May 28, 1907. Manufactured by

The Oliver Manufacturing Co., Philadelphia, Pa.

RECEPTACLES, STANDARD.

"P. & S. Fielding" Weatherproof cleat type. Cat. 820. Approved May 16, 1907. Manufactured by

Pass & Seymour, Solway, N. Y.

ROSETTES, LINK FUSE.

"Thomas," cleat and concealed types, both regular styles, Cat. Nos. 3414, 3415, and bracket styles, Cat. Nos. 3417 and 3418. Approved May 20, 1907. Manufactured by

Perkins Electric Switch Mfg. Co., Bridgeport, Conn.

SOCKETS, WEATHERPROOF.

"Bryant." Bracket style, Cat. Nos. 9496, 9448, 1251 and 1348. Pendant style, composition shell, Nos. 60,666, 43,310; porcelain shell, Nos. 9,366, 9,388, and "Bragdon," Nos. 50,997 and 1,398. Approved May 16, 1907. Manufactured by

Bryant Electric Co., Bridgeport, Conn.

INDUSTRIAL

THE ELECTRIC DRIVE.

Let us consider the application of electric motors for power purposes, particularly in comparison with the mechanical method of distributing power by belts and shafting. This is generally known as "the electric drive," sometimes as "the motor drive." For the last ten years this subject has been discussed to such an extent in the technical press and at the meetings of engineering societies that it might seem to have become "shop-worn" and leave very little of importance to be said. But to quote one writer: "We are passing through an era of astounding industrial development and the electric drive is but part of a general movement toward the highest economy in production." For the large manufacturing establishment, as well as the small manufacturer, repair-shop man and user of light machinery, there is no problem of more vital importance than that of obtaining a cheap, reliable and simple source of power. We often hear the statement: "The question now is not whether to use the electric drive but which of the electrical systems is best adapted to the individual requirements." However, in spite of this somewhat general opinion, and despite the extremely rapid introduction of electric motors, it is doubtful if more than ten per cent of the power in the United States is distributed electrically.

The advantages claimed for the electric drive may be summarized as:

Economy.—The power costs less and the cost for maintenance and repairs is also less. Electric systems are more efficient and there is entire absence of power loss when machines are not in operation.

Reliability.—There is no more reliable source of power than an electric generating plant in which proper attention has been paid to duplication of apparatus. Further, "throwover" connections to central station supply insure against stoppage due to a breakdown.

Flexibility.—Individual machines may be located as best suits general economic conditions or sequence of operations, without reference to lines of shafting. Enlargements can be made easily and without shutting down or changing the existing plant. The speed of each machine is independent of that of others, and its speed can be adjusted or controlled through a wide range by simple devices easy to operate.

Convenience.—With motors connected to individual macranes or by hoists. Lighting, ventilation, cleanliness, and shafting, which permits the handling of material by electric cranes or by hoists. Lighting, ventilation, clenaliness, and sanitary surroundings are secured. A pleasant, well-lighted, well-ventilated and easily accessible store or factory is an absolute essential to any man desirous of making the most of his business. Faults of machinery in operation can be easily detected. Where the material is heavy, portable tools, each with its connected motor, may be used. There is a saving of floor space and room can be left for movement of operators and material.

As results of these advantages many installations have proved that there is a notable increase in quantity as well as quality of the output of factories using the electric drive.

For a time the cost of power was considered the deciding factor in comparing the electric drive with other methods, such as belts and shafting. From numerous tests, it was found that the power lost in belts and shafting varied from 5 to 80 per cent in different cases; we may take 50 per cent as a fair average in a large plant using a number of machines. Considering such an average case where the machines require in the aggregate 1000 horsepower, then, using the belt and shaft system, we should expect the losses to be not less than 1000 horsepower with all machinery operating fully loaded. This would require 2000 horsepower from the driving engine and give an efficiency of 50 per cent. But the examination of hundreds of cases has proved that the average load on such a plant would be 300 horsepower; that is, the average load factor is about 30 per cent. So the belt and shaft system at this average load would require about 1300 horsepower from the driving engine and give an efficiency of 23 per cent, whereas the electric drive would require but 420 horsepower and give an efficiency of about 70 per cent.

In some instances, the deciding factor in favor of the electric drive lies in the fact that each machine can be driven at the speed best suited to its operator and to the work it is doing; this applies particularly to machine tool operation. In some practical tests with lathes the motor drive with speed control resulted in a saving in time of 42 per cent over any other system of speed change alone. The introduction of "high-speed" tool steel and the necessity of redesigning machine tools, together with accurate speed control requirement to take advantage of high cutting speeds has resulted in a more general adoption of the electric drive in machine shops.

In other cases cleanliness is essential, as, for example, in printing and in textile mills; or it may be that safety controls as in powder mills. In shipbuilding the tools are so widely scattered that the electric drive has been generally adopted.

As a prominent engineer sums it up: "The main cause of the success of the electric drive lies in the increased efficiency of human energy secured by it."

Careful analyses of shop costs have of recent years been made for many manufacturing plants. In one case the following figures were obtained:

Cost for material	50 per cent
Cost for labor	40 " "
Cost for power	2 " "
Cost of supplies and repairs	3 " "
Cost for interest and depreciation	4 " "
Cost for insurance and taxes	1 " "
Total	100 per cent

From the study of such tables of cost data it is evident that the cost of power is only a small per cent of the total cost of an article; generally less than four per cent. The cost of material depends upon the laws of supply and demand and the foresight of purchasing agents. The labor cost, however, can be reduced, and in many instances is reduced, by using the electric drive, since it is possible to increase the number of articles manufactured per man and per machine.

To suit different requirements a number of types of motors have been developed, of which only the fittest have survived. The electric motors in use today are the results of the most drastic evolution and of care, painstaking effort and endless experimentation. They may be divided into two general classes:

1. Direct Current Motors.

2. Alternating Current Motors.

Direct current motors include the shunt motor, the series motor and the compound motor. Alternating current motors include the single-phase induction motor, the poly-phase induction motor, the single-phase series motor, and the single-phase repulsion induction motor.

The different kinds of service demanded of electric motors may be classified as follows:

1. Service requiring constant speed with varying loads, with no control of speed beyond its being kept automatically constant. Many automatic machines used in manufacturing and small groups of machines driven by one motor with a little belting and shafting—group drive—come under this class. Textile mills are good examples. For such service either direct-current shunt motors, single-phase induction motors, or poly-phase induction motors may be used. If this service is varied by having a large number of starts, stops, and possibly reversals, compound motors may be used in place of shunt motors, but in this event constant speed is not obtained. The compound motor is of particular value, however, in reducing the fluctuation of power from the mains.

2.—Service requiring large starting torque (turning moment) for rapid acceleration and comparatively smaller running torque with frequent starts, stops, and reversals.

Street railways, cranes, and hoists are examples. For this service it is common to use series motors, though the single-phase series motors recently developed have similar characteristics and will doubtless have the preference in many cases in the future. Induction motors have been used but they are not inherently suited to the work. Elevator service differs from the above in that the cage is counterweighted; hence, special compound motors are used, particularly as the racing of the series motor would be liable to cause accidents. It is for elevator service that the single-phase repulsion induction (or "Schuler") motor has been developed.

3.—Service requiring a torque which increases with the speed.

Blowers and fans are examples. In general, the power increases very rapidly with the speed, and care is necessary in selecting motors for this service. The compound motor with a small amount of speed control by adjustment of resistance in the shunt field is in general satisfactory.

4.—Service requiring constant torque.

Pumps and air-compressors are examples. The series winding is beneficial for this service on account of its steadying effect on the power mains in case there is a large fluctuation in torque in passing through different parts of the cycle. Fly-wheels are also advantageous. Compound motors may be used. If the torque is to be kept constant through a wide range of speed, the method of voltage control (to be described under the next class) may be advisable.

5.—Service requiring approximately the same maximum output through a wide range of speed, with close speed regulation on any notch of the controller. This service includes most machine tools, and for it a number of methods of speed control have been devised. The systems of speed control are:

1. Rheostatic Control.
2. Field Control.
3. Voltage Control.

"Rheostatic Control" is obtained by inserting a resistance in series with the armature to cut down the speed. Its advantages are simplicity and cheapness. Its disadvantages are that it is wasteful of power, and that when the resistance is set the speed varies greatly with varying loads.

"Field Control" is obtained by putting a resistance in series with the shunt winding of a shunt or compound motor, thereby weakening the field, and causing the motor to run at proportionally higher speeds. A range of speed control of ten to one, say from 120 revolutions per minute to 1200 revolutions per minute, is possible by this method with specially designed motors. Ordinarily, however, a range of three to one is used.

"Voltage Control" consists of using special devices, such as an auxiliary generator to give a range of voltages which are applied to the armature of the motor. The field strength of the motor being constant, its speed will vary in direct proportion to the voltage applied to the armature. The advantages of the systems of voltage control are:

Sparkless operation of motor at all speeds.
Wide speed range.
Constant maximum torque throughout speed range.
Good speed regulation.
Good efficiency.

The disadvantages are complexity and extra cost of special devices.

6.—Service requiring approximately constant speed with load varying very little, but requiring a very slow speed to "make-ready," as in printing-press operation. Shunt or compound motors with rheostatic control may be used, though for this service there are also a number of special systems somewhat similar to those just mentioned.

A close examination of the requirements of practical operation which have been classified and a study of the characteristics of different types of motors will reveal the fact that for almost every variation in service demanded, there will be a motor and system of control peculiarly applicable, safe, reliable, and simple to operate.

In this general and rather brief discussion many interesting details have of necessity been omitted, but enough has been proved as to the advantages of the electric drive to warrant the conclusion that it will gradually replace other methods of transmitting and distributing power.—Condensed from an article by Professor H. B. Shaw, in the "Engineering Quarterly," University of Missouri.

SHAWMUT ENCLOSED FUSES.

Shawmut enclosed fuses are approved by the Underwriters' National Electric Association. They are accurate indicators, simple in construction, with perfect contact terminals, with either black tubing or copper finish. Each fuse is carefully constructed, inspected and tested. Large sizes packed in separate cartons; small sizes in boxes containing 100, 0-600 amperes, 250-volt, 600-volt, manufactured by Chase-Shawmut Company, Newburyport, Mass.

ALLIS-CHALMERS EQUIPMENT USED IN TRACTION SYSTEMS.

The growth of electric traction has, within the past ten years, expanded many times beyond the expectation of its most sanguine supporters in the early days. Street and interurban railway interests are to-day listed among the most active and the most valuable properties. No expenditure of money or of engineering skill has been spared in the design and use of electric generating and driving equipment. For a good many years Allis-Chalmers engines have been the standard prime movers for driving electric generators in many traction systems over the country; and scarcely second to the extensive use of this company's Corliss engines, Allis-Chalmers electrical generators, for both alternating and direct current have been installed by traction companies large and small.

In the past two years Allis-Chalmers Company has taken full advantage of its unique position industrially by assuming responsibility for the construction of entire traction systems, including any type of prime mover required—steam engine, steam turbin, gas engine or hydraulic turbine, electric generators, transformers, rotary converters, motors, air brakes and all auxiliary apparatus for power house and substations.

Wi.hin this time the equipment of six complete electric traction systems has been undertaken, aggregating a total of 318 miles of trackage, of which 150 miles are already completed and in daily operation.

Toledo, Port Clinton & Lakeside operates from Genoa, near Toledo, to Port Clinton and Marble Head, Ohio, over a total trackage of forty-five miles. A complete Allis-Chalmers plant has been installed here, including two 800-kilowatt engines and generators; fifty-foot cars equipped with quad 50-horsepower motors, designed for a speed of approximately forty-five miles per hour; three substations of 400 kilowatts each, complete, and all auxiliary apparatus.

Cincinnati, Milford & Loveland Traction Company. For two years the company operated ten miles of electric railway between Cincinnati and Milford. The power for operating was purchased from another company. After deciding to build an extension of the system from Milford to Blanchester, a distance of twenty-one miles, the company also decided to build and equip a power house of its own. The total trackage, with the extension, is approximately forty miles. The power station is equipped with two 500-kilowatt engines and generators, transformers, rotary, etc. Three substations of 400 and 300 kilowatts are provided complete, together with a line of cars propelled by 40-horsepower motors. The entire equipment was built by Allis-Chalmers Co.

Winona Interurban Railway Company's road runs from Warsaw and Winona Lake to Goshen, Ind., with an extension to Peru, Ind., giving a total trackage of seventy-seven miles. The power station is equipped with two 600-kilowatt engines and generators, transformers, rotaries, etc., to provide for a transmission voltage of 33,000 volts on which the system is operated. Seven substations of 300 kilowatts each, all complete, and sixteen cars equipped with quad. 75-horsepower equipments are provided. Cars are sixty feet over all, designed for a speed of fifty-six miles per hour. Allis-Chalmers Company equipped this road complete from power-house foundations to air brakes. The road is auxiliary to the Winona Assembly, whose "Chatauqua," held each year at Winona Lake, attracts over three thousand visitors every summer, not to mention the ordinary traffic of other seasons.

Indianapolis, New Castle & Toledo system, which is now nearly completed, operates from the center of the city of Indianapolis, eastward to New Castle, Richmond, and other cities in Indiana, with the intention of ultimately reaching Toledo, O. The total trackage now under construction is ninety miles. The power station consists of two 1,000-kilowatt steam-driven units, transformers, rotary, etc. The transmission voltage used is 33,000. There are ten cars equipped with 75-horsepower equipments, and four substations of 400 kilowatts each, complete. These cars are sixty feet over all, and designed for a speed of approximately sixty miles per hour. It will serve as the only means of railway communication with Indianapolis for a large percentage of the population reached by its service; in fact, no portion of the trackage is crossed by a competing railway.

Indianapolis, Crawfordsville & Western system will operate from Indianapolis, westward to the city of Crawfordsville, Ind., and is intended to connect with the McKinley Syndicate lines in Illinois. The trackage will be forty-five miles in length. The power station consists of two 700-kilowatt engine and generator sets, equipped with transformers, etc., all complete. Transmission voltage is 33,000 volts. There are three substations of 300 kilowatts each, complete. Ten cars fitted with quad. 75-horsepower equipments are provided, designed for a speed of sixty miles per hour.

Milwaukee Northern line will operate from Milwaukee to the town of Port Washington, Wis., over a trackage approximately twenty-five miles in length. The power house consists of three 1,000-kilowatt twin tandem gas engines and generators, and complete auxiliaries, including transformers for 22,000-volt transmission. This installation will constitute the largest in America of gas-engine-driven electrical units used for traction purposes. Eight substations with complete equipments, including switchboards, are included.

Allis-Chalmers Company's steam turbines and gas engines each bid fair to rival its reciprocating engines for electric railway service, and this company finds itself in a unique position, indeed, when it is able to furnish a prime mover of whatever kind required, in addition to the complete power equipment, from engine foundations to car motors, controllers and air brakes.

Owing to the demands of increased business the Holophane Company (sales department) has recently enlarged its office. It now occupies the eighth and ninth floors of the Glackner Building, 227 Fulton Street, New York City.

The engineering department of this concern is composed of some of the best-known illuminating engineers in this country.

The Holophane Company (sales department), 227 Fulton Street, New York City, has just opened a branch office at 157 Minna Street, San Francisco, California, under the management of Mr. F. H. Poss, who is well known to the trade on the Pacific Coast. It intends to carry a large line of globes and reflectors at this office, which will enable it to make prompt deliveries; this being in keeping with the well-known policy of the Holophane Company. Only standard packages will be sold.

NEWS NOTES

ELECTRIC RAILWAYS.

The new interurban line between Des Moines and Boone, Iowa, has been placed in operation.

A. C. Volk of Duluth, Minn., has announced his intention of building a street-railway line from that city to West Duluth.

The Biwabik Mining Company has made a proposition to the council of Biwabik, Minn., to furnish electric lighting for that city.

The Menominee (Mich.) Insulated Electric Wire Company has been incorporated with a capital of $100,000. Henry Tideman is president.

Bids have been taken at Spring Grove, Minn., for extensive improvements on the municipal lighting plant and for additional machinery.

Contracts for the construction of a two-story brick transformation plant for the Omaha (Neb.) Electric Light and Power Company have been let.

The Omaha and Council Bluffs Street Railway Company has purchased a site for its news car barns. The building will be 150 by 450 feet and will cost $70,000.

The Sioux Falls Light and Power Company of Sioux Falls, S. D., has been organized with a capital of $750,000. E. W. Coughren is president and Fred Reed secretary.

The Chicago and Northwestern Railway Company is said to be investigating the possibility of developing water-power at Glendale, Wis., for use as auxiliary power in hauling trains over the heavy grades between Kendall and Sparta.

It has been announced that C. C. Goodrich, vice-president of the Twin City Rapid Transit Company, is interested in the Mesaba Traction Company, which proposes to construct an electric line connecting the various towns on the iron range in Northern Minnesota.

Judge Lochren of the Federal District Court has appointed E. L. Hospes receiver of the Stillwater Gas and Electric Light Company. The property will not be sold, but the receiver will continue the business. The company on January 1st defaulted in the payment of the interest due on $150,000 of its bonds.

C. C. Cokefair of Duluth, Minn., president of the Mississippi River Electric Power Company, has disposed of his large holdings in that concern to Archibald S. White of New York. The plans, as outlined by Mr. Cokefair, provided for the development of about 60,000 horsepower between Elk River and St. Cloud, Minn. It is not announced what Mr. White's plans in the matter are.

POWER AND LIGHT PLANTS.

Tacoma, Wash.—The city will receive bids on any kind of power plant that will supply not less than 4,000 kilowatts of electricity, up to and including July 3rd.

Tacoma, Wash.—W. A. Aldrich, manager of the Tacoma Gas Light Company, says that the capacity of the plant will be doubled. Seven carloads of pipe are now on the way from the East, for new extensions.

Waterville, Wash.—The City Council passed the ordinance granting a franchise to the Waterville Colling Co. permitting it to use the streets and alleys of the town to maintain an electric line to operate the mill.

Wenatchee, Wash.—Arthur Gunn, of Wenatchee Electric Company, has purchased $60,000 worth of new machinery in Seattle, and an additional power plant will be built down town. It is to be running by October.

Waitsburg, Wash.—Mayor Lloyd stated that the power company has been incorporated for $30,000, and now has a crew at work extending their barrel flume up the river. At the intake a reservoir will be built for the purpose of creating a reserve supply of water. The extension of the flume is expected to materially increase the power at the plant and thus enable the company to furnish the city a better service of both light and power.

Minneapolis, June 8.—Under a decision filed by the Minnesota Supreme Court recently, the interurban lines of the Twin City Rapid Transit Company are defined as common carriers, having the right of eminent domain and not subject to the franchise powers of incorporated cities and villages. The case came from the District Court of Hennepin County, where the case was decided otherwise. The Minneapolis and St. Paul Suburban Railway Company will be thus enabled to extend its line from Excelsior, Minn., to Tonka Bay at once.

San Francisco—A call for a national industrial peace conference to meet in San Francisco in July has been issued by the conciliation committee of San Francisco with the encouragement of President Roosevelt. The committee expects that this national conference will effect a condition of permanent industrial peace in this city, show to the east that the labor conditions are not entirely hopeless and that the rumors that the "town is to be tied up" are false. The provisional dates for the meeting are July 18, 19, and 20.

At this gathering it is proposed to organize a branch of the national civic federation. President Benjamin Ide Wheeler of the University of California, who is now in the East, will bring to the conference authority for the establishment of the California branch of that organization. The gathering will be attended by three, and possibly four, members of President Roosevelt's cabinet and by 1,200 delegates from California and the East. Many labor leaders are expected to be present, including Samuel Gompers and John Mitchell.

The cabinet members whose attendance is assured are Secretary of the Navy Metcalf, Secretary of Commerce and Labor Oscar S. Straus and Secretary of the Interior Garfield.

In planning the conference the conciliation committee will have the active co-operation of the Chamber of Commerce of San Francisco, the California Promotion Committee, the civic league of San Francisco, the San Francisco church federation, the California club and similar organizations.

FINANCIAL.

Los Angeles, Cal.—By a vote of 10 to 1, Los Angeles has declared for the bonding of the city to the amount of $23,000,000, for the building of a municipal water system.

New York.—The Mercantile Trust Company, as trustee under the mortgage or deed of trust of the San Francisco and North Pacific Railway Company, invites proposals for the sale to it, before the close of business on July 6th, at its offices, 120 Broadway, in the city of New York, of bonds secured by said mortgage or deed of trust, at a rate not exceeding par and 10 per cent premium, to such an amount with the premium as shall not exceed $25,000.

San Francisco, Cal.—Judge Seawell has sustained the demurrer entered by the Spring Valley Water Company in the suit brought by the City of Paris Dry Goods Company for an injunction to prevent the water company, owner of the property at the southeast corner of Geary and Stockton Streets, formerly occupied by the City of Paris as its tenant, from reconstructing the building in any manner other than the one adapting it to use as a department store. An appeal will be taken.

San Francisco, Cal.—At the meeting of the Board of Supervisors last week, the following resolution was referred to the Public Utilities Committee: "Resolved, That the city and county attorney be and is hereby instructed to institute such proceedings as may be necessary to revoke and cancel the franchises granted by the city and now held by the United Railways and the California Street Railway on such line or lines as said corporations have failed to comply with the terms of their franchises and neglected to give adequate service to the public."

San Francisco, Cal.—The recently published statement that former Mayor James D. Phelan, through the co-operation of President Roosevelt and Secretary Garfield, of the Department of the Interior, had secured the Hetch-Hetchy or Tuolumne River system for San Francisco, was the incentive for the following telegraphic correspondence: San Francisco, June 7, 1907. Honorable James R. Garfield, Secretary Department of the Interior, Washington, D. C.: This morning's newspapers state that James D. Phelan telegraphs from Washington, stating that he has practically concluded negotiations with the Federal authorities by which San Francisco would secure possession of Hetchy-Hetchy. In view of our large investment, made in response to Board of Supervisors' request for bids to furnish San Francisco with a municipal water source, we respectfully ask that before final action we be afforded opportunity to show that we can furnish larger supply of Sierra water and at less cost than can be brought from Hetch-Hetchy, and that no reason obtains for converting the Yosemite National Park into a water supply course for San Francisco or depriving irrigationists of much needed water. William S. Tevis, President Bay Cities Water. "Washington, D. C., June 8, 1907. W. S. Tevis, President of Bay Cities Water Company, San Francisco, Cal.: There is no application pending from Mr. Phelan or any one else relative to the Hetch-Hetchy water supply. No recent action has been taken. J. R. Garfield, Secretary."

TRANSMISSION.

Gardnerville—W. Stephens was in Gardnerville this week on his way to Mono County, where he goes to look after his interests there. Early last year he located power rights on the west forks of the Walker River, at a point known as Chris Flat. It is now claimed that the California-Nevada Electric Company has located the same rights. A lawsuit will most likely result, and it is stated that both sides will fight to the bitter end to gain possession of what is perhaps the most valuable power site in this section of the country.

Searchlight, Nev.—A number of mining men of this place are promoting a scheme for the installation of a large electrical power plant on the Colorado River that will furnish power and light to all the mines and towns in the southern portion of Nevada and particularly to the mines of Searchlight. The promoters state that a gigantic power plant could be built on the Colorado River, and that the electricity could be used to supply power to hundreds of mines, and also in operating railroad lines in this section.

Colusa, Cal.—The Board of Supervisors of Colusa County has accepted the bonds and granted the application of Charles Glen, A. S. Linderstrom and C. B. Wickes for a franchise to erect poles and string wires for the transmission of heat and power in Colusa County. They were the only bidders, and the sum bid for the franchise was $100. Satisfactory bonds were furnished in the sum of $2,000, with B. H. Burton and James Stoval as sureties. The new company intends getting power from Stony Creek, where the building of roads is already under way, but they also intend erecting a plant for generating power.

Napa, Cal.—The second step toward acquiring rights of way for his electric power line project has been taken by Henry Brown, the banker, who has applied for a franchise to the City Trustees of the town of Calistoga. Mr. Brown, representing San Francisco capital in the project, has secured a right of way over the principal roads of this country. He also has an application pending before the St. Helena Town Trustees, and will no doubt soon make application to the Trustees of the city of Napa and of Vallejo. Banker Brown is still reticent as to whom he is representing, but the thorough manner in which he is spending money for his rights of way about this country, proves that it is a big enterprise; a dangerous competitor for the Bay Counties Power Company, and also the small power concerns that furnish power and light to the up-valley towns. No action will be taken on Mr. Brown's application by the Calistoga Trustees for two weeks.

Manton, Cal.—The big reservoir which the Northern California Power Company has been building at Macomber Flat, has just been completed, and the water has been turned into it. The large force of men which has been upon it is being transferred to the power site on Battle Creek, where work is being rushed by the same company in an effort to make good its title to 80,000 inches of water claimed by the Pacific Power Company. A six-horse load of men, tools, bedding, etc., passed through Manton Saturday on its way from Macomber Flat to the Battle Creek Dam. At Chico connection is made with the Valley Counties Power Company, which is a part of the Martin-De Sabla system, and power is transmitted to Sacramento, San Francisco, Oakland and other cities. There are persistent but wholly unverified reports in circulation here to the effect that President White, head of the Pacific Power Company, and Engineer Sutcliffe, of the Northern California Power Company, are in consultation looking to a transfer of controlling interest in the former corporation to the latter, and that a merger of the Pacific with the Battle Creek Company is planned.

ELECTRIC RAILWAYS.

Everett, Wash.—The Washington Railway & Electric Co., which has been working in the vicinity of Sultan for months, securing land and making arrangements for the development of the water-power of the Sultan River, while its plans thus far have been kept in the dark, is known to have a big trolley proposition in view. As a part of the work a tunnel 6,000 feet long will be driven near the Sultan River. It is known that back of the power scheme is the contemplated construction of a trolley line connecting Everett and the Sultan country and perhaps extending still farther eastward. About $30,000 has already been expended and $50,000 more will be spent this season.

Bellingham, Wash.—It is reported here a company has been formed to build an electric line from a point in the Methow Valley, possibly at Twisp, to Barron, in the heart of the Slate Creek district. The name of the company is not known in Bellingham.

Boise, Ida.—A park to cost in the neighborhood of $100,000, to erect buildings and prepare a lake, fully equipped with everything for comfort and pleasure, is to be built by the Boise & Interurban Company, four miles down the valley, near the company's power house now in the course of construction. The directors of the Boise & Interurban Company have fully decided their road shall be extended through the Payette Valley, and have given this matter entirely into the hands of W. E. Pierce and F. H. Knox, chief engineers for the company.

Helena, Mont.—The survey for the Helena & Butte electric line has been completed, and it is expected that within two weeks a reliable estimate as to its costs, as prepared from the field notes, profiles and topography, accurately determined, will be submitted to the board of directors. The directors of the company with whom will rest the option of ordering immediate construction work, after the cost has been submitted to Supervisor Verharden, is as follows: F. A. Heinze, John S. M. Neill, M. H. Gerry, Jr., F. S. P. Lindsay, G. L. Ramsey, J. T. Stanford, O. M. Lanstrum, N. B. Holter, W. T. Hull, H. G. Pickett and A. C. Johnson.

Coeur d'Alene, Ida.—The Spokane, Wallace & Interstate Electric Railway filed the plat of definite location of its right of way at the U. S. Land Office. The survey leaves Coeur d'Alene and follows east along the shore of the lake to Wolf Lodge Bay. From the end of the bay it follows the creek in an easterly direction until it strikes the Coeur d'Alene River about three miles west of Rose Lake. It follows the river then until it reaches Wallace. At the divide there will be a 4,000-foot tunnel. The heaviest grade on the whole line is not over two per cent., and this is only for two miles on each side of the divide. The balance of the grade is one per cent or less. The work on the grading will begin about the first of August.

Kamloops, B. C.—City is figuring on enlarging its light plant.

POWER AND LIGHT PLANTS.

Victoria, Wash.—Victoria Gas Co. plans five miles of new mains, at a cost of $25,000, this season.

Rockford, Wash.—The Rockford Brick Co. is making preparations to install a 50-horsepower electric motor to operate their plant.

Mabton, Wash.—E. F. Benson, of Prosser, will extend his power transmission line from Byron to this place if granted a franchise.

Aberdeen, Wash.—The Grays Harbor Electric Co. has a force of men engaged in construction of its new power plant. The company will spend $350,000 in betterments.

Boise, Idaho.—The Telluride Power Co., of which L. L. Nun is the head, is installing a plant which will develop 25,000 horsepower and cost $2,000,000. Machinery is hauled from Alexander by traction engines.

Olympia, Wash.—A. E. Wright, of Portland, who will install the new gas plant, has moved to this city, and construction work is to commence at once. Four miles of pipe are on the way from the East.

Walla Walla, Wash.—The old Mill Creek power plant formerly used by the Northwestern Gas & Electric Co., is being enlarged and rebuilt, and a large force of men under Supt. Young is making every effort to complete the plant before the summer is far advanced.

Centralia, Wash.—A number of capitalists, represented by G. W. Gregory, a Seattle attorney, propose to install a water, light and power plant. The intention is to bring water down from either the Shookumchuch or Chehalis Rivers, for power to generate electricity and for drinking purposes.

Sandpoint, Ida.—J. L. Drumheller, of the local light and water company, is in the East endeavoring to sell bonds so that the water company may make use of a 10,000-horsepower right it has, and thus enlarge the local plant to accommodate cheap power for manufacturing industries. The electric day service, Mr. Reynaud announced, would be put on June 1st.

Vancouver, B. C.—B. A. Leslie, of Ashcroft, reports that an electric lighting plant is being installed at the Bear property on Cunningham Creek. The dynamo will generate electricity sufficient to operate four flaming arc lamps of 3,200 candlepower each. These lamps are a new thing in lighting, only being out a year. They are manufactured by a German firm, and are the most powerful light known.

Tacoma, Wash.—E. W. Commings, of Seattle, has made an offer to the City Council to build a water power plant which will develop 10,000 horsepower for $75,000. The plant is to be located on the Puyallup River, near Electron, and Mr. Commings' proposition provides that Tacoma shall buy the landsite and the right of way to the city. The committee is also figuring on a fuel gas producer plant and a steam turbine plant.

Portland, Ore.—Capitalized at $1,000,000, the Economy Gas Co. was incorporated by E. E. Lytle, D. G. Tomasini and R. W. Colson. The new concern is backed by local capitalists, and has for its object the laying of mains to engage in the sale of gas throughout Portland. It is proposed that 95 cents per 1,000 cubic feet will be the maximum price of gas, and that not less than $5,000 a year shall be spent for maintenance of the plant. It also agrees that 1 per cent of the gross earnings shall be paid to the city every year. The ordinance, if approved, will prevail for 25 years, at the end of which period the city will have an option on the purchase of the plant.

ELECTRIC RAILWAYS.

San Francisco, Cal.—The Board of Works has ordered a notice sent to the United Railroads to remove the cable conduit and to lay heavy rails on Ellis Street, from Market to Larkin, at once, in order to permit of the paving and widening of the roadway.

Reno, Nev.—An effort is being made by Francis G. Newlands to effect a merger of the Reno Development Company and the Nevada Interurban Railway Company, in order to end the disastrous railway and real estate war which is now engaging the rival transaction and dirt-selling corporations.

Fresno, Cal.—The Supervisors have ordered the publication of an advertisement for sale of the twenty-five-foot strip through the county hospital tract that will be occupied by the double-track lines of the electric road to Recreation Park. The sale of the twenty-five-foot strip will take place at auction on July 12th.

San Francisco, Cal.—The Merchants' Association has addressed a communication to Mayor Schmitz urging him to veto the item in the budget which appropriates $720,000 for the reconstruction of the municipal street railway on Geary Street. The letter advises the Mayor that there are many things which the city needs more than a street railway, and further suggests that the sum in the budget is illegal and that litigation following its passage might tie up the whole budget so that it could not be used.

Vallejo, Cal.—The Vallejo, Benicia and Napa Valley Railroad Company is in receipt of 900 tons of rails and other material for the extension of the line up the Napa Valley, and it is intended to commence work at once. With the material which has just been received it will be possible to complete the extension of the road as far as Oakville, and it is expected that by the time this section of some fourteen miles is finished, shipments will have been received here sufficient to permit of the work on the line to St. Helena being taken up.

Stockton, Cal.—Samuel B. McLenegan, the new manager of the Central California Traction Company, arrived in this city this week and assumed charge of the local railway. Manager McLenegan was for five years the general superintendent of the Huntington interurban system in Los Angeles, and has been actively engaged in electrical railroad work for fifteen years. Manager McLenegan hopes to rush the work of the Lodi extension to the earliest possible completion, so as to handle the crops along the company's route at the end of the season.

Vallejo, Cal.—During the past ten days Mr. Dozier and Attorney T. T. C. Gregory of the road have arranged for the purchase of $110,000 worth of rights of way in Solano County alone. The company is also preparing to press its suit for condemnation in Yolo County. Dozier has stated that in about two weeks the engineers of his line, and those of the Northern Electric, will hold a joint conference in Sacramento with the Government Engineer, the Board of Supervisors of Sacramento and Yolo Counties, and the City Trustees of the Capital City, to determine the location of the bridge across the river, whereby the electric road will enter Sacramento. Whether or not the Vallejo and Northern line will use the steamers of the Monticello Steamship Company, between this city and San Francisco, is still a question which Dozier refuses to confirm or deny.

Washington, Spokane.—General Manager J. B. Ingersoll, of the Spokane & Inland, has announced the inauguration of a passenger service south from Oakesdale to Garfield and Palouse, a distance of nearly twenty-five miles. For the present it is probable that trains will reach Garfield by electric power, and then proceed to Palouse by steam, as the overhead construction is still incomplete between those towns. The extension of the train service will require an entire new train schedule. Three through trains will be run between Spokane and Palouse in either direction. Trains will leave Spokane for Palouse at 7:35 a. m., 1:30 p. m. and 4:55 p. m. Trains will leave Palouse at 7:55 a. m., 12:15 p. m. and 4:55 p. m. Trains on the eastern or Palouse division will not make stops between Spring Valley Junction and Spokane, going or coming, but will make all stations below the junction. The running time between Spokane and Palouse will be 3 hours, until the roadbed becomes more settled, when it is probable the time will be reduced. By the new schedule the forty stations between Spokane and Rosalia, on the western division, will be served by four trains each way, as at present. South-bound the trains will leave Spokane at 7:00, 9:40, 1:00 and 5:30, while trains will leave Rosalia for Spokane at 6:00, 9:30, 1:45 and 4:15. With the opening of train service to Palouse the Spokane & Inland will be operating 81 miles of road, 76 from Spokane to Palouse, and 5 on the western division, Spring Valley to Rosalia. This, with the 44 miles now in operation on the Coeur d'Alene division and the 23 miles operated by the Spokane Traction Company, makes an aggregate mileage of 150 for the Inland Empire system.

OIL.

Bakersfield, Cal.—The Associated Oil Company is preparing to install a new first-class boiler plant at McKittrick. Five 70-horsepower boilers will be installed, and as soon as material can be secured work will begin on the new derricks.

Coalinga, Cal.—The California Oil Fields, Limited, is putting down two or three wells on section 27-19-15 which will be near the line adjoining the Oil City Petroleum (Standard). It is also putting three new rigs on the N. E. quarter of section 34-19-15, and one on the S. W. quarter of the same section. No. 2, which is on the territory of the old Forty Oil Company, is being drilled deeper.

Benicia, Cal.—Active work on the big oil refinery which Los Angeles and San Francisco capitalists are to build on Bay Shore, between Vallejo and Benicia, will be inaugurated this week. A party of eighteen boilermakers will arrive from the East to commence the erection of the big tanks, which will be preliminary work at Glen Cove site. Already Davis Fleischer, of San Francisco, who is acting as the agent for the oil men, has secured a wharf franchise at that point, and will immediately start the erection of a big wharf structure. It is announced that a large hotel for the accommodation of the workmen is also to be constructed at once.

Los Angeles, Cal.—The Amalgamated Oil Company is running twelve strings in the effort to keep production up to the demand. All other operators in the field west of the city are also running one or more strings each. In the matter of getting oil for the needs of the market, companies are largely in the same fix, none having any to spare. At this time it looks as though the Union, with its big supply at Santa Maria, pipe line to Port Hartford, ships and pipe line from San Pedro to the city, ought to be in a better position to get outside oil in than any other. The Associated, of course, could bring Coalinga oil by sea from Monterey, if it were not all needed elsewhere, but it has no pipe line from tidewater to the city as yet. The Union Oil Company has four strings at Fullerton. In the Sterans No. 4 well, near the Columbia, 2,700 feet of casing are now in the hole, which is about the longest string in use.

ILLUMINATION.

Los Angeles, Cal.—An ordinance granting the Pacific Light & Power Company a franchise to operate and maintain an electrical pole and wire system upon all public roads in the County of Los Angeles, has been passed.

Sonora, Cal.—An application has been received by the Trustees from Attorney F. P. Otis on behalf of W. A. Weidemann for a franchise to install and operate a gas lighting plant in Sonora. The Board resolved to meet next Saturday to consider the matter.

Ocean Park, Cal.—E. B. De la Mar, representing the Sprague Meter Company, of Bridgeport, Conn., says that the company will establish a gas plant in opposition to the Edison Company, if he received enough local support to insure an apparent success. He has made arrangements to spend ten days here, and will decide what action will be taken in the matter.

Alameda, Cal.—The electrical committee's plans call for the construction of a new fire-proof building, the installing of a new unit, new boiler, and the extending of a power and electric city service. The estimated cost is $58,000. In case the $58,000 is allowed $18,000 will be expended on the new building of steel, $25,000 will go for the new unit, $6,000 for boiler, $1,800 for improvements to power service, and $1,500 for improving the lighting service.

Reno, Nev.—Manager Campbell, of the Reno Light and Water Company, and Broili, of the Truckee River General Electric Company, have received instruction to institute immediate improvements in two systems now supplying light and power for this city. They state that more than $30,000 would be expended on the work. The company will first remove the substations of the Truckee River General Electric Company and the Reno Power, Light and Water Company out of this city limits, establishing them at the old power station on the south bank of the Truckee River, near the western limits of the city.

San Francisco, Cal.—John A. Britton, president of the Gas Company, has informed Chairman Gallagher, of the Supervisors' Finance Committee that there will be a deficit of $12,000 in the fund for lighting public streets for June. The deficit was due to the extra lighting of Van Ness Avenue, Fillmore, Devisadero, and other streets. Gallagher assured Britton that the deficit would be at least partially made up so that the streets could be lighted every night, contingent upon the amount available in the surplus fund, which must be drawn upon to pay claims of merchants against the school department aggregating $106,000, for other purposes.

INCORPORATIONS.

Porterville.—The Heat, Light and Power Company has been incorporated with a stock of $50,000, by A. J. Newbury, V. D. Knupp, J. F. Canty, H. C. Carr, J. H. Williams, W. E. Sproot, H. F. Brey and T. L. Price, $5,000 each, and J. N. Larson, $10,000.

Goldfield, Nev.—The Goldfield Gas and Coke Company has been organized with a capital of $800,000. The entire capital stock has been subscribed in full by local and Eastern capitalists. A site has been secured and the erection of the plant and the installation of the mains throughout the city as well as Diamondfield and Columbia, will be commenced at once. It is estimated that the first cost of the plant will be $400,000. The plant will be enlarged from time to time, and its capacity increased as the consumption of the gas warrants.

WATERWORKS.

W. C. Robinson, chief engineer of the National Fire Protection Association, of Chicago, has been for several days inspecting the plans of the proposed salt-water auxiliary high-pressure system, prepared in the office of the City Engineer. Robinson was engaged by the local fire underwriters to perfect the plans, and the proposition will be submitted to a vote of the people for the issuance of bonds to the amount of $7,500,000. The system, if put into effect, will lower the insurance rate and increase the fire protection of this city.

Berkeley, Cal.—A petition from a number of West Berkeley manufacturers requesting the Trustees to take some action to give the factory district better protection and suggesting that a salt-water plant be installed, came before the Board. Superintendent Maloney states that work is soon to be prosecuted on a 24-inch main, which will extend from San Pablo down that avenue to Russell Street, and up that street to the reservoir at Webster and Claremont. The pipe will represent an outlay of $250,000, and will be completed in three or four months. The entire length of the pipe will be 65,000 feet.

James D. Phelan, of San Francisco, is in Washington on an errand connected with a project to secure Hetch-Hetchy Valley and Lake Elanor as the supply of a new water system for San Francisco. He called on the President, Secretary Garfield, Forester Pinchot, and others interested. Secretary Garfield promised Phelan that he would go immediately into the law points involved in the Hetch-Hetchy project, and that he would grant a hearing in San Francisco next month to all parties interested. He and Forester Pinchot will go into the Yosemite during their trip to the Coast, and will personally inspect the proposed storage sites. Garfield is believed to have an opened mind on the subject, and the policy followed by former Secretary Hitchcock may be reversed.

San Francisco, Cal.—Colonel Heuer says of the plan to bring water from the Hetch-Hetchy Valley: "While the engineering features of the Hetch-Hetchy scheme have received extensive comment, the financial aspects of the undertaking might prove the greater difficulty. Grunsky's estimate of the cost of the system, which was made in 1903, was $39,000,000. It was later shown in the hearing held before Judge Morrow that Grunsky had omitted from his estimate necessary features to the extent of an additional $16,000,000, which would increase the estimate to $55,000,000. At the same time, the cost of labor and materials have increased 25 per cent since 1903, which would make the cost of completing the work at present to nearly $69,000,000. These figures include the cost of duplicating the Spring Valley distribution system, which, if deducted, would leave $61,000,000 as the present cost of bringing water from the Yosemite to the city. If the plan to purchase Spring Valley and construct the Hetch-Hetchy system in addition should be adopted, the total cost to the city would be $91,000,000. From this might be deducted the $16,000,000 for which it is said the Merced lands could be sold, and another $17,000,000 which might be obtained from the sale of the Calaveras system. After disposing of these two properties to Spring Valley, which would not be required in conjunction with the Hetch-Hetchy system, the final cost to the city would be $58,000,000."

TRANSPORTATION.

San Diego, Cal.—When the City Council opened bids for a franchise on Fourth Street, from C to B and along B to the Water Front, as asked for by E. B. Webster, it was found that Webster bid $100 and that John D. Spreckels had bid $1,250. The award was to have been made to the highest bidder. The matter was referred to the Street Committee.

Lodi, Cal.—The grade for the extension of the Central California Traction Company's line to this city will be completed next week, and it is expected cars will be running to Lodi by July 1st. Cars will probably be running from Stockton to the Calaveras River by the middle of June. Samuel B. McLenegen, superintendent of the Huntington interurban system of Los Angeles, has resigned his position to come to Lodi to take charge of the construction work here.

San Francisco, Cal.—The Supervisors have amended the budget in order to block any attempt at stopping the appropriation of $720,000 of next year's revenue for the reconstruction of the Geary Street road. As passed last week, this item made up nearly the whole of the 20-cent emergency tax levy which the Board proposed to lay upon the city in addition to the dollar rate. As amended yesterday, the budget calls for this item within the dollar assessment rate permitted, and $720,000 is to be raised "for repair, sprinkling and sweeping of the streets," as an emergency measure, by adding the 20 cent extra levy.

Woodland, Cal.—A party of surveyors is engaged in this city for the Vallejo and Northern electric road. They made their lines on Second Street throughout its whole length, and it is expected that the electric railroad lines will run out on Second Street in a southerly direction; thence on to Winters and Vallejo. The passenger depot and ticket office will be located at the corner of Main and Second Streets, where the Niclas Building now stands. It is expected that the railroad will commence the construction of the road from Vallejo to Cement, and thence will proceed on to Cordella, Winters and Woodland. At Cement one branch of the road will be built to Sacramento to secure a franchise from the City Council of Sacramento to lay the tracks of the road in that city.

Oakland, Cal.—All the fuses and switchboards of the Key Route system were burned out a few days ago, and Tony Pereira, the engineer in charge of the power station at Fortieth and Hollis Streets, was severely burned on the face, neck and hands by the short circuiting of the electric current. The accident occurred just after the last Key Route train had been run into the barn. Pereira reached for the switch to throw off the power, and suddenly there was a tremendous flash that temporarily blinded him and caused him to stagger about like a drunken man. He was conveyed to the receiving hospital in the police ambulance, and his burns were dressed by Stewart Borchert. The fuses were replaced and the switchboards repaired by the Key Route electricians, so that traffic was resumed the next morning as if nothing had happened.

FINANCIAL.

San Francisco, Cal.—The North Mountain Power Company has levied an assessment of 19 3-10 cents per share, delinquent July 6th; sale day, August 6th.

San Francisco, Cal.—The West Shore Oil Company held its annual meeting of stockholders on June 11th, 928 Monadnock Building, San Francisco.

CLASSIFIED LIST OF ADVERTISERS

FINANCIAL.

San Francisco, Cal.—The Spring Valley Water Company has filed, in the United States Circuit Court, a suit against the City and County of San Francisco and the Board of Supervisors, asking that defendants be restrained from enforcing the water rate established by the Supervisors. This is the fourth suit of the same kind that the company has filed since the water rates were made in 1903.

San Francisco, Cal.—The Executive Committee of the Allied Commercial Association, which has undertaken the solution of the difficulties between the Spring Valley Water Company, its rate payers and the city, has received from the water company an offer for the sale of its entire plant to the city, in accordance with the plan of long-term option adopted at the first meeting of the committee. The exact sum for which the Spring Valley Water Company agrees to deliver all its property to the city is not available for publication, but it is known that it is approximately the total par value of the bonds and stock of the corporation, which amount to $34,000,000. Various estimates have been made on the value of the property, both by the company's engineers and the experts employed by the city. The lowest appraisement was $24,000,000, and the highest $51,000,000, but it is sufficient that the mean of these estimates is approximately $34,000,000, which is the sum of the outstanding securities of the corporation, and, it is understood, very nearly the amount at which the Spring Valley now offers the city a ten-year option on its entire plant. While the market value of the stocks and bonds only foots up $24,000,000, it is contended that a court, if asked to pass on the question, would, in all probability, strike an average of the various estimates and arrive at the decision that $34,000,000 was a fair valuation.

ILLUMINATION.

Los Angeles, Cal.—The Town Trustees of Vernon have refused permission to the City Gas Company to erect a plant within smokeless precincts of their model little city. They are searching for a new location.

Lodi, Cal.—Actual work has been commenced on the gas plant for this city. A force of men is laying six-inch pipe along Sacramento and Elm Streets, from which points smaller pipes will be laid. The plant will cost $75,000, and will be completed about October 1st.

Napa, Cal.—W. J. Lindow has been granted a franchise to erect and maintain an electric light system along and across the city streets. Under the decisions of the Court the franchise does not have to be published or advertised for sale, and Mr. Lindow can commence the work of placing the poles at any time.

Now that the Western Pacific grading is nearing completion on that poriton of the route extending from Oroville through the lower part of the Feather River district, the Truckee Lumber Company is contemplating a short line railway feeder from the Western Pacific to the center of their vast timber holdings, in the watershed of French Creek, in the vicinity of Bigbend on the Feather River, where a large mill will be located.

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The JOURNAL OF ELECTRICITY POWER AND GAS

WITH WHICH IS INCORPORATED
The Engineers', Architects' and Builders' News

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THE

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The Engineers', Architects' and Builders' News

VOLUME XVIII. SAN FRANCISCO, CAL., JUNE 29, 1907 No. 26

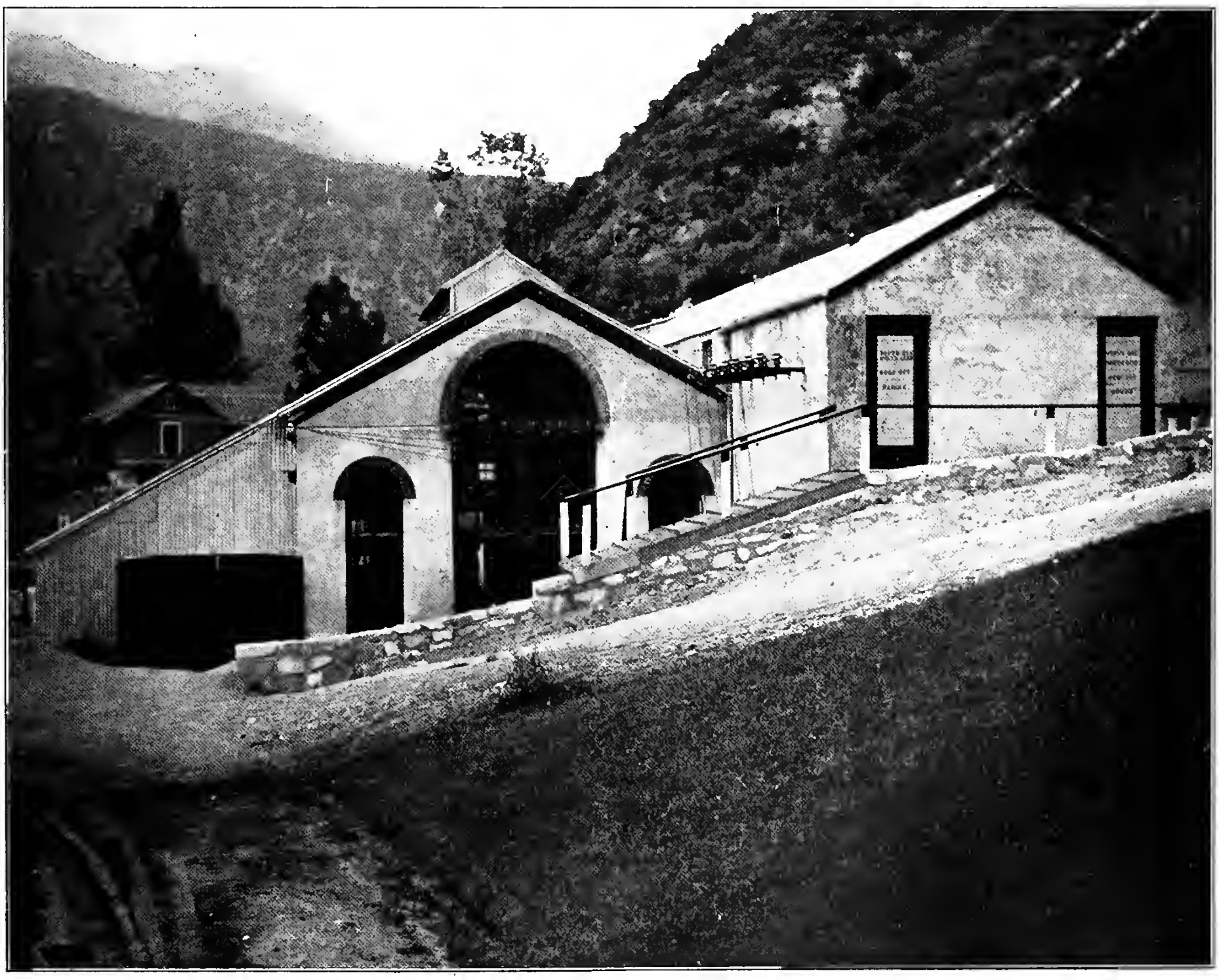
AZUSA STATION, PACIFIC LIGHT AND POWER CO.

The power house at Azusa is one mile north of Azusa near the San Gabriel River. This plant was the first hydro-electric power plant built by the Pacific Light and Power Company and is now used as the control station for the whole system, all the lines from the different plants coming through this station.

Head Works and Conduit.

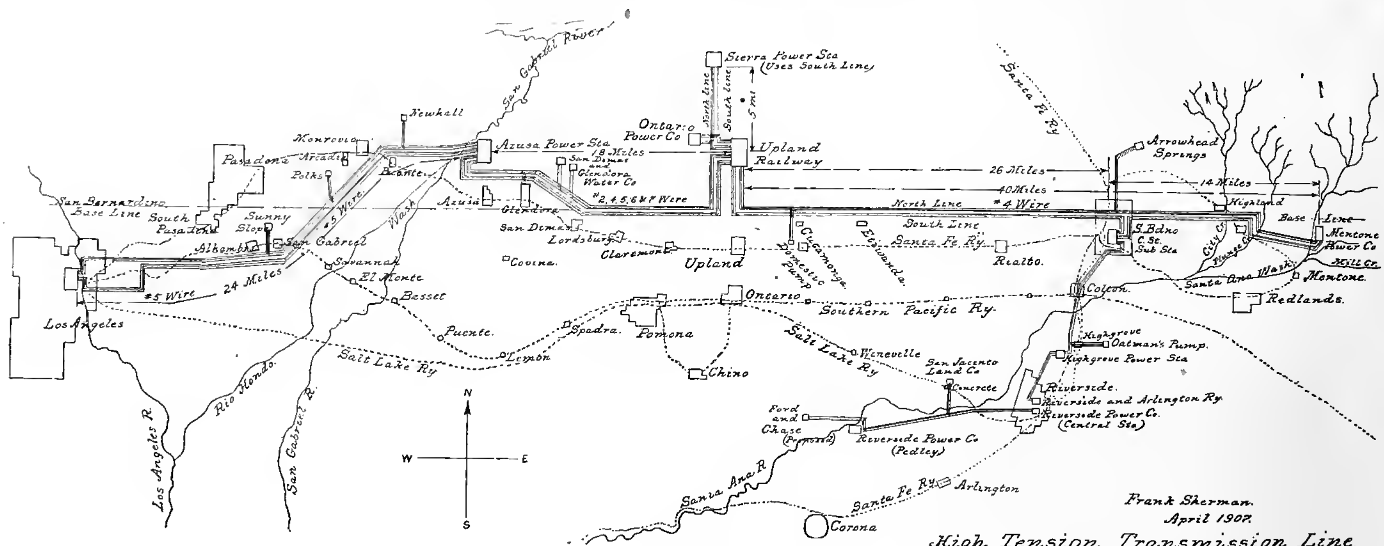
The intake was planned at a narrow place in the San Gabriel River about seven miles above the power house site. Concrete piers were sunk in the river bed at this point, and the flow of water, governed by flash boards between the piers, runs directly into the tunnel, which emerges from a jutting bluff of solid rock into the river. The water is conveyed to the forebay through a conduit system seven miles in length, consisting of tunnels and modern flumes. The tunnel which carries the water two-thirds the distance was driven by hand through solid rock, the surface being plastered to present a uniform surface area. That part of the conduit from the end of the tunnel to the forebay consists of wood-stave pipe, five feet in diameter, bound by round steel hoops, the entire pipe being encased with concrete eighteen inches thick.

The forebay is situated on the hillside 404 feet above the



SOUTH END OF AZUSA POWER HOUSE – SHOWING BUS GALLERY.

power house. The pressure main, consisting of thirty-eight inch riveted steel pipe, is protected by a grizzly where it enters the forebay to caach all debris which can be easily raked off. Two spillways were constructed to handle the excess water, or, in case of a shut-down, to carry away the full head. One of these which carries excess water is built straight down the hill to the waste way. Owing to



High Tension Transmission Line.
Pacific Light and Power Co.

the slope of the hill, which is on a 45-degree angle, the other one which is used to carry the full stream in case of a shut-down, is constructed with three water pockets to break the force of the full head of water which it carries.

Power House and Equipment.

The power house is constructed of reinforced concrete with corrugated roofing. Four 300-kilowatt, Westinghouse, 50-cycle, 2-phase, 500-volt generators, running 430 revolutions per minute, are installed direct connected to four double Pelton water-wheel units, the wheels having two discs per unit. Two of the units are governed by Lombard Type "F" governors, while the other two are hand controlled. Belt-driven from the generators are four 7½-kilowatt, Westinghouse, direct-current multipolar, 125-volt generators used as exciters.

The transformer room, above which is the bus gallery, is situated on the uphill side of the building, running its entire length and extending at the north end, where is located the air compressor and an auxiliary pump for circulating the water in the transformers and around the bearings should the gravity water system be tied up. In this room are eight 200-kilowatt, Westinghouse, oil-insulated, water-cooled, 50-cycle, step-up transformers, stepped up by the Scott connection from 500 volts, 2-phase, to 17,500 volts, 3-phase.

About three miles south of Azusa is located the Covina sub-station, through which power and light is supplied to Covina and the adjoining country. This building is not shown in the map, having been built in November, 1906, and is just now nearing completion. It contains three 37½-kilowatt, oil-insulated, air-cooled, 50-cycle, Westinghouse transformers, 15,000 volts stepped down by delta connection to 2200 volts.

At Glendora is another sub-station with the same equipment, supplying power to that vicinity, and a little further east the San Dimas and Glendora Water Company taps the north line for power. Power is also supplied to the Upland Railway Company through both the south and north lines. Just below the Sierra power plant is located the Ontario power house, which is tied into the high tension lines of the Sierra Power Company.

The accompanying cut is from a tracing made by F. W. Sherman, formerly of the Pacific Light and Power Company, and shows how nearly the transmission line follows the San Bernardino base line. There are two high-tension transmission lines called the north and south lines, with corresponding bus systems in each of the power houses and sub-stations. The north line is used in most cases as the feed line for power and light in small towns and vicinity, and for pumping stations. Several towns have been supplied with power since the map was completed and are not shown as being tied in.

Sierra power station is situated on Lydle Creek, not shown on the map. The Ontario Power Company's plant is tied in on both lines.

The south line only comes into the San Bernardino C Street sub-station and is carried down to Riverside. Since the Pacific Light and Power Company has taken over the Riverside Power Company, the line from the latter company's plant has been tied into the main system at Central Station in Riverside. A line has been run to a pumping station due north of Pedley within the last few weeks. The map was not drawn to scale from a survey, but it gives a very clear conception of the general route followed by the transmission line.

INSULATOR TEST.

A series of interesting tests of insulators has been completed recently in connection with the plans for the Ocean Shore Railway, which will parallel the shores of the Pacific Ocean for nearly eighty miles between San Francisco and Santa Cruz, California. The transmission line is to be operated at 33,000 volts in connection with various sub-stations distributing the power along the line. It will be close to a dusty county road for much of its length and is exposed to salt spray from the ocean in several places. Consequently there is great danger of burnouts caused by the insulators becoming coated with dust from the road and salt from spray and fog.

In order to save time the test was conducted under artificial conditions approaching the natural as closely as possible, except in regard to time duration. "Fog boxes" were tried. The insulators included a 16-inch, 60,000-volt porcelain with corrugated top, a 14-inch, 60,000-volt, smooth top, a 9-inch top 35,000 volt porcelain, a Kern type insulator and one of special design.

The results showed that such insulators must be cleaned every third or fourth year if used for 33,000 volts or over. The "fog boxes" increased the time between cleanings for the smaller insulators but were impractical for the larger on account of size and expense. The fog caused but little trouble, the main difficulty beingexperienced with salt and dust. An insulator that would probably prevent arcing is one made up of several pieces of porcelain or glass shaped like the ordinary insulator tops and placed one below the other, exposing a large part of the surface to wind action. A flat top is advisable.

SALES CONTRACTS.*

B. A. Brennan.

It is well known that those charged with the duty of making and approving contracts are oftentimes meagerly alive to the fundamental features of contractural obligations, and if one were to study the subject, observing the faulty character of most contracts and considering the tremendous volume of business which is transacted under such contracts with comparatively little complication and misunderstanding, it would, of necessity, make him an optimist. His recognition of the evidence that most business is conducted on faith, with an underlying spirit of confidence pervading most commercial transactions, would convince him that most people are honest, and demand merely that to which they are entitled. It will not be disputed, however, that contracts are necessary as a record of understanding, and they are necessary, too, as a precaution to both parties. On the first count, they should be specific in the expressed terms, and in the second instance, they should, by observing all necessities of the business, protect both parties from the risks, liabilities or penalties which, in spirit, they are not to assume, nor can they afford to assume, and which otherwise, either through ignorance of equity, or direct intent, would be forced upon them. It is not the salesman alone, nor the officer who passes upon the form, who requires to know how a contract should be drawn and its provisions interpreted. A contract once made, may require the participation of many in its execution, and every man connected with a business is obligated, both to himself, his employers and associates, to familiarize himself with the general legal regulations covering business intercourse or business agreements.

In the consideration of this subject, it must be remembered that statutory provisions exist in most States, and that the same differ widely in character with respect to the technical provisions of form and procedure.

Every one knows that a contract is an agreement, but how many of us realize that an agreement is not always a contract? It might be a contract, but to be so, it must possess certain elements which are required by law. An agreement is simply the meeting of minds; whereas, a contract is an agreement between parties, which, for a consideration from one to the other, creates an obligation on each to perform his respective covenants. Every agreement is not enforcible. To be enforcible, it must contain the legal elements known as "competent parties," "mutual assent," "lawful subject-matter," and "sufficient consideration." All of these are necessary to a perfect contract, and the absence of any one of them affects the contract. In some instances, depending upon the nature of it, the absence of any one of these elements makes the contract unenforcible; in others voidable, and in still others, absolutely void.

There must be, at least, two parties to a contract, and they must be competent. By "competent" is meant natural persons or corporations with legal right of contracting.

NORTH END OF AZUSA POWER HOUSE—LINES LEAVING POWER HOUSE

*The "Electric Journal."

Natural persons, in this sense, are those of legal age, and those who are not incapacitated by physical or mental conditions which exclude consent, or by law or statute which prevents certain persons from entering into contracts or restricts their power to do so. The legal age of males is twenty-one years, and the same in most States for females, although in some States the legal age of females is eighteen years. Persons under age are termed minors. As a rule, contracts with minors are voidable, the idea of such law being to protect those under age against the consequences of their own discretion or against the imposition of others. Minors are liable, however, for all necessaries of life. Other persons not competent parties to valid contracts are:—convicts during the continuance of their conviction, insane persons, or those who can prove that they were non compos mentis at the time of contracting; persons intoxicated, or under the influence of drugs, so as to be deprived of consciousness of what they were doing at the time of contracting. Corporations usually have the same power of contracting as natural persons, but contracts made by them must be either expressly or impliedly authorized by their charter or act of incorporation.

Mutual assent is the meeting of minds. Obviously, there can be no contract if there is no agreement, and unless the parties have in mind the same understanding, with the common intention of binding themselves and each other by the arrangement, there can be no agreement. However clear the agreement may appear on its face, it can be conclusively shown that it was not mutually understood, it cannot, in general, be enforced. The parties must communicate to each other their common intention, and no contract which the law will recognize and enforce exists until the respective parties have agreed upon the same thing and in the same sense.

Every contract must necessarily be the result of an offer on one side and its acceptance on the other. The acceptance must be in a simple and direct affirmative, and if the party receiving the proposal accepts it on any condition, or with any of its terms or provisions changed, unless the same be altogether immaterial, it amounts to another proposal by the other party, and there is no contract until the party making the proposal consents to the modification, either in writing or by overt acts amounting to the same thing. To be certain of proper mutual assent, every agreement should be written and signed by both parties and everything agreed upon should be written distinctly. Care should be used to say all that is meant and nothing else, for it is a rule at law that no oral testimony shall control a written contract unless its wording is so ambiguous as to practically demand definition of intention, or unless fraud can be proven. As a rule, any contract may be altered after execution, by consent of the parties, and any changes made at the time of or prior to the signing of the contract become elements in it. Any changes, however, after execution makes a new contract out of the original, and accordingly any guarantor, or third party to it, not assenting to the change is released from his obligation.

In the absence of fraud, a person is bound by his written agreement, notwithstanding he may have misapprehended the legal effect of it. Parties to contracts are assumed to know the liabilities imposed upon them by law. In order to charge one who can neither read nor write, with liability under a contract, it must be shown that the contents of the paper were fairly read or explained to him. A party negligently signing a contract without reading it cannot avoid it by claiming afterwards that it contains provisions he did not understand or know of at the time of execution. Fraudulent representations made prior to the consummation of a contract, operating as an inducement thereto, and relied upon by the party to whom made, will defeat recovery by the party making them. Likewise a contract obtained under duress is void.

The subject-matter of a contract is the basis of the contract itself, and is descriptive or applicable to the promises of the parties, comprehending both the consideration to each and their respective obligations. Lawful subject-matter, as implied from its title, requires that the basis of the contract shall be of legal character, and that the agreement itself shall otherwise conform to the legal requirements. The law refuses and forbids contracts involving agreements to perform an act forbidden by statute, or acts which in the law are penalized. Under this category would come agreements to pay usurious interest, contracts of wager, contracts for services of one who sets himself up as a physician who has no diploma, contracts made on Sunday, contracts to commit crime, civil wrong, or fraud on creditors. The law also forbids contracts opposed to public policy, as being injurious to the interests of the public. These are generally classed under agreements which tend to injure the public service, and of which graft is a striking example; agreements tending to obstruct the course of public justice, such as agreeing to suppress evidence at a trial; agreements tending to encourage litigation; agreements contrary to good morals, those restricting the freedom of trade, or those affecting the security of property and life.

It is difficult to clearly define Consideration as applied to contracts. Generally speaking, however, it consists of the reciprocal and mutual promises between the contracting parties. It might be called the benefits which each party receives, or the something to be performed or given in exchange by one party to the other for the inducement. The law says that consideration of some legal character is absolutely essential to a valid contract, and it further says that the consideration must be valuable and good, and must consist of some benefit, interest, right or profit to the parties, which denotes some substantial cause for the promise. For example, if A owes B $100, and B tells A he need not pay it, B can afterwards, nevertheless, repudiate his concession, on the score that there was no consideration for it.

Impossible conditions will void a contract; that is, where at the time the agreement is made it is known by the parties that a promise is physically impossible of performance. It must appear, however, that the promise cannot by any physical means be accomplished, and not that its fulfillment is deemed impossible because it is difficult and absurd.

In a sales contract the price is the consideration on one side, and the furnishing of the goods on the other. To constitute a sale, there must be something to sell. This does not mean that a concern could not sell or contract to deliver a turbine or generator not yet built, but that any hope or expectation of means, founded on a right in being, may be the subject of sale, because in such case there is a potential existence. But a mere possibility or contingency, not founded upon a right or coupled with an interest, cannot be made the basis of a valid contract.

Price in a contract of sale is essential to its validity, and must be either determined or determinable. It need not necessarily be paid down, but there must be an agreement to pay. In the absence of a fixed price, the law would imply a promise to pay as much as the property was reasonably worth. If the contract be silent as to the time of payment, a cash sale will be presumed.

Every agreement must necessarily result from an offer or proposal on one side and an acceptance of it on the other. To illustrate: The sending of an order to a merchant or manufacturer is an offer to purchase, and the sending of the goods is the acceptance of the offer and creates the contract. The entering of a street car and riding in its amounts to an agreement by the railroad to carry the person on the usual route, at the usual fare, and an agreement by the passenger to pay the usual fare. A man, with full knowledge of another, does work for him, the latter knowing that he expects to be paid for it; the doing of the work is the proposal and the receiving of the work without

dissent is the acceptance. If a man sends goods to another, and the other accepts the goods, or uses them, it implies a contract, and the user is liable for what the goods are worth.

In the preparation of a contract, it is important that it be grammatically written and construed according to the rules of grammar. This is not, however, an absolute rule at law, as it is not material in what part of the instrument any clause is written. It will be read as of any place and any context, so long as its certain and evident intent requires it. It is dangerous, however, to permit inaccuracy or confusion in the arrangement of clauses, because the true intent may thus be distorted and not admit of ready construction. There are many words and phrases which have one meaning in ordinary narration, but quite another when used as technical description, or words in relation to some special subject, and it must be supposed that the words as used are in the specific and technical sense applicable to the subject. In the construction of contracts, the main idea is to determine the intention of the parties, and it is a rule that the whole contract shall be considered in determining the meaning of any and all of its parts.

Contracts are often construed by the courts as including all matter which it is clear the parties intended, whether expressed or not, and to contain not only the expressed agreements but those implied as well. That is to say, usages or customs of a country may affect the meaning of certain words. How plainly this would apply to engineering questions, where usages and practice may affect the meaning of certain words, and where incidents universally attaching to the subject-matter must be presumed to have been in contemplation by the parties. It is settled law that every trade has its usages and that these usages are a part of every contract with reference to the subject-matter.

In the interpretation of contracts of which a part is printed and part written, the printed parts are subordinated to that written, if they are in conflict and tend to different results. Mistakes in contracts can be rectified, if it can be proven that the parties intended to use one word, but used another by mere verbal error in copying or writing.

Contracts made on Sunday are governed by the laws of the particular State, but, generally, contracts executed on Sunday or legal holidays are void.

Contracts and bargains can be, and frequently are, concluded by written correspondence. An offer having been made through the mail, the proposing party may be regarded as tendering the postoffice as his messenger, and when the other party accepts by post the agreement is complete and the contract made. The party to whom the proposal is sent must accept and mail his acceptance in due season, and if the one proposing desires to retract or modify it, he must communicate it to the party addressed before said party has mailed his acceptance, otherwise the proposer is bound. The proposer may, however, stipulate in the proposal that it shall not be considered as binding until the acceptance is actually received.

A salesman is usually authorized to do the specific thing of selling, being furnished with contract or proposal forms.

Frequently the salesman or engineer has occasion to go out and confer with customers relative to the details of contracts or the specifications. His company, wishing to have him received with standing, advises the customer that Mr. So and So will call, etc., and instead of restricting his authority, rather emphasize it to some extent. How many of us appreciate that by simply doing this, the company may equip the salesman with authority to obligate it to an extent which may involve great expense? How many of us realize that on such occasion a mere word or admission, the customer will permit of its ready installation without or assent, might bind the company beyond any degree of reason. The law says that unless the principal shall in some positive way notify the other party of the limit of the authority of his salesman or agent, he may be bound to the full extent of the salesman's acts; for a principal is responsible for the acts of his agents not only when he has actually given full authority to the agent to act for him, but when he has by words or acts, or both, caused or permitted the person with whom the agent deals to believe him clothed with this authority; and, if the agent transcends his actual authority but does not act beyond the natural and usual scope of business, the principal is bound, unless the party with whom the agent dealt knew the agent exceeded his authority. If a customer can prove that a salesman made certain promises or certain statements at the time the contract was entered into, thereby substantially interpreting the spirit of the contract, the law would interpret such verbal promises or statements to be collateral to the agreement, and on which the customer could place valid claims.

The matter of terms of payment under a contract is one of its most important features, and we all know that the machinery manufacturer is oftentimes compelled to furnish apparatus for which he does not receive full payment on shipment. The general rule on small product is about one-half of the purchase price on shipment; the remainder thirty days after shipment; although, in some instances, where the customer is not strong financially, payment before shipment is often exacted. On larger product, where the building of the apparatus requires any length of time, during which period a large amount of money is necessarily tied up in raw material, a portion of the purchase price is usually made payable as the work progresses in the shop; another payment when the apparatus is substantially completed in the shop, and the third payment on shipment, or delivery, with the balance within a reasonable time thereafter.

The all-important consideration in contract terms is that they be specific. A contract is always faulty, the terms of which permit of diverse interpretations, and oftentimes extended terms are less objectionable if they be clear and unquestionable, than short terms with an uncertain basis of maturity. The greatest conceivable defect in expressing terms of payment would be to have them dependable upon the customer's temperament, mood, or, perhaps, caprice. The employment, therefore, of such terms as "satisfactory operation," "erected complete," "tests to verify guarantee," "when in successful operation thirty days," or, in fact, any contingency which would permit the customer himself to define the terms contrary to the seller's intention or the spirit of the contract is dangerous and costly and should not be used.

APPARATUS FOR GENERATING ELECTRIC POWER.*

By JOHN HARISBERGER

In my first lecture I mentioned that when transforming and transmitting energy of a waterfall for a distant market, loss of power occurs. To keep this loss at a minimum is necessary for profitable commercial results.

I have also described how the power of a waterfall can be transformed into mechanical energy with very little loss. We now come to the point where it must be decided into what form the mechanical energy must be changed so it can be transmitted a long distance at minimum loss. It has been proven that power in the form of electricity can be transmitted at less loss than any other way.

Apparatus for generating electric power, when it is intended for long-distance transmission, generally consists of alternating current dynamos, exciters and their accessories for controlling and metering the power. Transformers for raising the electric pressure may also be included. The amount of power and the distance to be transmitted will determine as to the advisability of using transformers.

There are three types of alternating-current dynamos in practical use—the revolving armature machine, the revolving field machine and the inductor type. The revolving field machine has proven the most satisfactory in many classes of work, as it permits the conductors to be thoroughly insulated and they are not subjected to the strains and vibrations as if they were on the rotating part. This is important, especially for high voltage machines; there are no collectors or brushes to insulate for high pressures as in the case of revolving armature generators, as the voltage of the field current in general practice is seldom more than 125 volts. Inductor alternators for equally good voltage regulation must be heavier and more expensive than the revolving machine. For a given amount of material and given cost, the revolving field machine shows higher efficiency and better regulation than either revolving armature or inductor types.

Armatures for alternating-current dynamos are wound for either one-, two- or three-phase. Single-phase have one winding; two-phase two distinct windings so placed that the voltage in the two windings will differ ninety degrees. In three-phase alternators there are three windings inter-connected in such manner that the voltage between terminals differ in phase 120 degrees. The usual method of inter-connecting the three windings is delta $\triangle$ or star Y. Except where existing single-phase or two-phase systems necessitate clinging to the old type, generators are now wound for three-phase, and for long-distance transmission other than three-phase should not be seriously considered. With a three-phase generator when armature is Y connected the voltage between line wires is $\sqrt{3}$ times the voltage of one winding and the current will be the same. When delta connected the voltage between line wires will be the same as in one winding, but the current will be $\sqrt{3}$ times as great in the winding as in the line. The static capacity in a delta winding for a given line voltage will be greater, as it requires a larger number of turns per phase than the Y winding, and there is consequently a larger percentage of slot space occupied for insulation. With a delta connection the phases form a closed circuit, and if the voltages are unbalanced, on account of unequal field strength or different number of turns per phase in winding, local currents can circulate in the armature. In a Y-connected armature two-thirds of the winding may be burned out during a bad short circuit, while in a delta probably only one-third.

The voltage for which generators should be wound depends upon their output. They are built anywhere from 440 to 15,000 volts, and may be built for voltages as high as has proven satisfactory for air-blast transformers, especially the stationary armature type. The higher voltage machine may be used for moderately long-distance transmission without the use of step-up transformers. For a given frame, the armature wound for the higher pressure, the cost will be greater than for low voltage on account of additional insulation and increased cost of construction. The output will also be reduced because of the increased space occupied by insulation.

If distance of transmission is not great, choice of frequency will depend on nature of load to be supplied; if it is mostly lighting, 60 cycles; if mostly power, 25 cycles. As far as generator is concerned, frequency depends only on the speed and number of poles. It is not influenced in any way by the style of armature winding or the method of connecting winding. Cycles per second =

$$\frac{\text{number of poles x speed per minute}}{120}$$

When deciding on a frequency for very long distance transmission, the transmission line must be given consideration, as the lower the frequency the better the regulation and the greater the capacity of the line, and the lower the frequency the less the charging current for a given voltage. Therefore, to transmit a given amount of power for a given loss, the transmission line would cost less for twenty-five cycles than for sixty cycles, but in total cost of system this would be partly offset by the extra cost of transformers and generators for twenty-five cycles than for sixty cycles.

In my last lecture* I stated that I would let the water-wheel builder choose speed for wheel and have speed as high as he could get the best efficiency, and then have generator built to suit this speed. The best frequency for a generator depends on the speed at which it is driven and on its capacity; this will also influence the choice of frequency. For a given capacity, low frequency for low speed and high frequency for high speed is desirable for generator, as far as cost and design is concerned. As to transformers the higher the frequency the smaller the weight and cost and the higher the efficiency.

Regulation of generators for transmission of power should be such that the voltage will not rise to too great a value on sudden opening of receiver circuit, speed and excitation being constant. Less careful attendance is necessary, as the change in exciting power for variation in load and power factor is less. Induction and synchronous motors may be thrown on the line with less disturbance, and excessive rise of voltage due to charging current prevented. Seven per cent regulation for generators seems to be good practice. Take a generator having 7 per cent regulation, running at full load, 100 per cent power factor, 2000 volts; when full load is thrown off, speed and excitation being constant, it will rise to 2140 volts. 2140—2000=140, or 7 per cent.

On a transmission system there is much line exposed, increasing the possibility of interference causing short circuit. This should also be considered, when deciding on regulation of generator, since good regulation implies a large current on short-circuit, and poor regulation the reverse is true.

When an alternator is running at no load the voltage remains constant; as soon as load is put on, voltage drops, excitation and speed being kept constant. This drop is due to three causes: Armature resistance, armature self-induc-

Lecture delivered to the students in Electrical Engineering, University of Washington.

tion and armature reaction. The drop due to resistance is a matter of cross section of conductors in armature winding. To keep down self-induction is a matter of arranging the armature conductors and core, as part of the generated voltage is used to overcome the self-induced voltage in the armature winding; it is a detriment to good regulation Armature reaction is the effect the armature current has on the field at different power factors; for instance, a load of 100 per cent power factor, or nearly so, as incandescent lamps, the current is nearly in phase with the voltage and affects the field only by distorting it, but causes very little drop in the voltage. Any drop in voltage under these conditions is caused mostly by the resistance and self-induction in the armature winding. When the load is inductive, so that it causes the current to lag behind the voltage, the field created by the armature current opposes the original field and tends to weaken it; this causes a drop in voltage, which varies according to power factor of load. When load is of a nature, such as over excited synchronous motors or transmitting power over a long line having large capacity that it causes the current to lead in relation to voltage, the effect will be the reverse, making the voltage rise instead of drop.

One method to reduce armature reaction is to make the field very powerful as compared with the armature. Arrangement of poles and shape of poles also influence the reaction effects of alternators.

The shape of the poles will also, to a certain extent, determine the wave-form of the generator. This should be a sine curve and generators that are to be run in multiple should have wave-form alike for best operating results. The wave-form is somewhat distorted by energy passing through transformers, motors, etc., and capacity of line, transformers and armatures is also an element that tends to distort shape of wave. Any apparatus generating a counter electro-motive force should have the same wave-form as generator supplying system from which it is fed, so it will tend to correct the distorting action.

To be able to run alternators in parallel is always desirable and generally necessary. The disturbing causes for operating in parallel are variation in angular velocity of prime mover and having electrical circuit connecting alternators together of too high an ohmic resistance. The remedy for the circuit is obvious, and as water wheels only are considered for prime movers there will be no variations in angular velocity to cause trouble.

When distance of transmission is more than fifteen miles, step-up transformers should be used to keep down cost of transmission line, as voltage necessary would be too high for generator to transmit a large quantity of power farther than this distance, with efficient results. It occasionally is desirable to use step-up transformers for much shorter distance to protect generators. In localities where lightning disturbances are very severe, it is probable that apparatus will occasionally be crippled. The apparatus connected direct to transmission line will be the first to suffer, and to have a transformer out of commission is not so serious as a crippled generator; besides an extra transformer is not so expensive as an extra generator. Transformers may be divided into two general classes according to the arrangement of the core and winding. The transformer where the iron surrounds the winding is called the shell type, and when the winding surrounds the core it is called the core type. Large transformers are generally of the shell construction because it is easier to secure good mechanical arrangement of the coils, and coils can be sandwiched and arranged so good circulation of oil can be obtained with better effects as to regulation than with the core type.

Step-up transformers in transmission plants should have the best regulation possible as short-circuit current of station can be kept at safe limit by proper design of generators; therefore, shell-type transformers will be preferable.

Transformers are either air-cooled, oil-insulated and air-cooled, or oil-insulated water-cooled. For a water-power plant I can imagine no good excuse for other arrangement than oil-insulated water-cooled, especially when water under pressure is available for circulating through cooling coils, as temperature can be better controlled at overloads than with the other arrangements, and transformers will be lighter and lower cost. Transformer groups may be connected either delta or Y. The transmission line voltage generally will determine the kind of connection to use. Up to and including 35,000 volts the delta connection is desirable and would be for any voltage for one reason, and that is in a case when one transformer of the delta is crippled the other two can be connected in V and will transform three phase current to their full capacity, less 15 per cent continuously. The strains upon the insulation of transformers are the $\sqrt{3}$ times as great with the delta connection as with the Y; therefore, the Y connection is desirable for the higher voltages. With the Y connection neutral should always be grounded so as to prevent it from shifting, for disturbance of the whole system may be caused by the neutral drifting and making possible a dangerous rise of potential.

Exciters should not be overlooked when designing a power station as they are some of the vital parts of the plant. There should be at least two exciters for a plant having more than one alternator and each exciter should be of such capacity so as to be able to take care of at least three alternators when intended for a station containing three or more generators. In a station containing ten

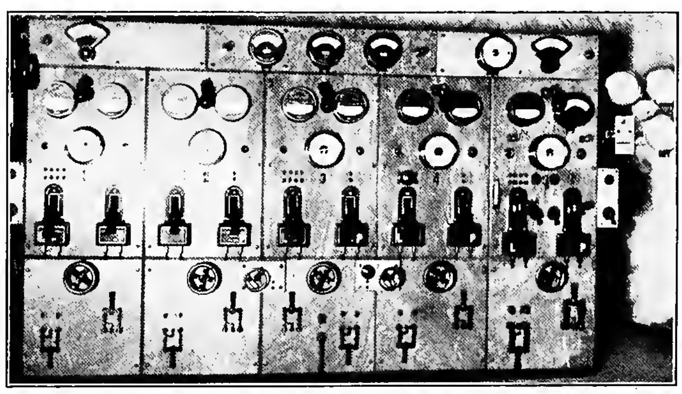


FIG. 1.

be able to take care of total of plant. Exciters should be wound for constant voltage, and when driven by induction motor, drop in speed of motor from no load to full load should be considered when designing compound winding for exciter to maintain constant voltage. In high head plants openings in nozzle tips of exciter wheel are of such size that a small obstacle may shut off the water. In a case of this kind it is good practice to have an electric motor connected to exciter in addition to water-wheel, so in case nozzle tip chokes up, speed of exciter is kept up by motor, which will be driven by current derived from alternator bus.

Figure 1 shows switchboard in generating station at Snoqualmie Falls. From this board are controlled five alternators and their water-wheel governors, also speed and voltage of two exciters and high tension line switches.

Generators are 3-phase, 60 cycles, 2000 volts.

Voltage of transmission line, 33,000.

Rated capacity of station, 12,000 kilowatts.

THE ECONOMIC STATUS OF THE ELECTRIC FURNACE.

By Wilder D. Bancroft.*

In the arc light and the incandescent lamp we have electricity used primarily as a source of light. At the same time there is a great deal of heat developed and these two forms of lamp correspond to the two types of electric furnace, the arc and the resistance furnace. These names in themselves describe the furnaces, the heat being generated in the arc in the first type, while in the second type the heat is caused by the passage of the current through a conductor which may be either solid or liquid.

When electricity is generated from coal, electrical heating is necessarily much more expensive than heating direct from coal, because we have the losses in the steam engine, the losses in the dynamo, and the losses in transmission and conversion. When electricity is generated from water power, the difference in cost may be less and cases are conceivable in which electrical heating might be cheaper, unit for unit, than heating from coal. Under any ordinary circumstances, however, we must accept the fact that electrical heating is an expensive form of heating and that the difference in cost must be overbalanced by some special advantage if the electric furnace is to compete commercially. When Cowles, a Cornell graduate, started to build a commercial electric furnace in 1884, he was laughed at on the ground that electricity was much too expensive a fuel.

Some possible advantages of the electric furnace are easily seen. With the arc furnace we get an intense concentration of heat with a correspondingly high temperature. With the resistance furnace we can regulate the supply of heat within very wide limits. By decreasing the cross-section of the resistor we can concentrate the heat at a particular point if necessary, though not to the same extent as in an arc furnace. By a suitable design of the resistor we can ensure a fairly unform distribution of heat throughout the length of the furnace. Since the heating is internal the problem of containers ceases to be a troublesome one and the outside of the furnace may consist of the unfused charge or of the chilled and solidified melt. Of course, in some cases of chemical heating, such as the rotary cement kiln for instance, we have internal heating; but this is by no means always possible. When we have external heating, the container must be less fusible than the charge because it is heated to a higher temperature. Apart from these two points of the greater flexibility of the current and of the advantage of internal heating, the electric furnace owes its commercial superiority to one or more of the following causes: the ability to reach temperatures inaccessible by other methods; the possibility of larger units and consequent decrease in costs; the greater purity of the product; increased reaction velocity due to a higher temperature; possibility of using cheaper raw materials owing to new reactions taking place at higher temperatures. As a matter of fact, each one of these is a factor in the successful manufacture of some product by means of the electric furnace.

When considering the economic status of the electric furnace, we must always keep in mind what is the nature of the competition which it has to face. Speaking broadly, the product of an electric furnace will have to compete with a natural product or with a manufactured product unless it happens to be a substance the like of which was not known before, in which case a demand must be created for it.

Let us consider a number of typical cases, showing what it is that enables the product of the electric furnace to compete successfully. First on the list comes graphite which is made at Niagara Falls in 1000-horsepower resistance furnaces. The temperature required is so high that it can be reached only in the electric furnace. Graphite competes with carbon electrodes and with natural graphite. Graphite electrodes cost more than carbon electrodes, but the difference in cost is more than counterbalanced in some industries by the lesser disintegration and longer life of the graphite. In so far as Acheson graphite competes with the natural product, the difference in cost is balanced by the greater purity of the artificial graphite.

Carborundum, SiC, is made by heating sand and coke in a 1000-horsepower resistance furnace. Owing to the high temperature necessary, the substance can not be made commercially by chemical heating. It does not occur in nature, so far as we know, except as microscopic crystals in some meteorites. Its chief use is as an abrasive and it competes with natural emery, and also with alundum, which is an artificial emery. Carborundum costs more than natural emery, but the difference in cost is balanced by the extra hardness and superior grinding power. Since alundum is made in the electric furnace, its competition with carborundum lies outside the scope of this paper.

Calcium carbide, CaC_2, is made in this country by heating lime and coke in 250-horsepower arc furnaces. In the Austrian Tyrol it is made in resistance furnaces. The temperature required is above that which can be reached successfully on a commercial scale by strictly chemical methods. Calcium carbide does not occur as a natural product and at present its sole commercial value depends on the fact that it reacts with water to form acetylene. The carbide industry, therefore, depends on the demand for acetylene. While calcium carbide is a powerful reducing agent, its cost is prohibitive.

If nitrogen be passed into a calcium carbide furnace, a product is formed which is called calcium cyanamide, $CaCN_2$. This can also be formed by passing nitrogen over calcium carbide heated to 1000°-1200° C; but this requires two operations and is therefore apparently not so satisfactory a method. This calcium cyanamide is a product not found in nature and it is to be used as a fertilizer, competing with sodium nitrate and ammonium sulphate. In the past the world's supply of nitrates for fertilizing purposes and for nitric acid has been drawn from the beds of Chili saltpeter in South America. The consumption of nitrates is increasing enormously every year and there is reason to fear that the saltpeter deposits will be exhausted by about 1940. In consequence the price of Chili saltpeter is rising rapidly. Five years ago calcium cyanamide could not have been manufactured at a profit; it is not certain that it can be manufactured at a profit today. If the price of sodium nitrate continues to rise, there will come a time when calcium cyanamide can compete successfully. The only doubtful factor is whether the supply of ammonium sulphate from coal will be sufficient to supply the world's needs at a price below that at which the calcium cyanamide can compete. There is no definite information as to this, but it is reported that the manufacture of calcium cyanamide is soon to be undertaken on a large scale at Spray, N. C.

While ammonium sulphate and calcium cyanamide, together with nitrogen-fixing bacteria, may supply the demand for nitrogen as a fertilizer, there is still the demand for nitric acid to be considered. It may be that this will be met by some method of oxidizing ammonia; but there is another way that is theoretically possible. In the atmosphere we have practically an inexhaustible supply of nitrogen. If this can be made to combine with oxygen, we can get oxides of nitrogen which can afterwards be converted into nitric acid. For over a century it has been known that oxides of nitrogen could be formed by the passage of an electric spark in air; but the difficulty was to make the process an economical one. Quite recently two Norwegians, Birkeland and Eyde, have worked out a method which gives promise of commercial success. A powerful solenoid is placed at right

*Sibley Journal of Engineering.

angles to the direction of the spark. The arc is deflected by the magnet and starts further and further back on the electrodes until finally it breaks and a new arc appears at the terminals. These changes occur so rapidly that to the eye there appears a continuous disc of flame. With 5000 volts and 500 kilowatts the disc of flame is over two yards in diameter. Through this disc air is blown and is converted partially into the oxides of nitrogen. The process is the most efficient that has yet been devised and is now on a semi-commercial basis. With a further increase in the price of nitric acid, the process should become commercially successful, unless some still better method is invented in the meantime.

The manufacture of graphite, carborundum, calcium carbide, calcium cyanamide and nitric acid has called for temperatures higher than any that can be obtained conveniently by non-electrical methods. We now come to a group of products which have long been manufactured by non-electrical methods.

The first of these is steel. As far as the ordinary grades of steel are concerned, the electric furnace will not be used for a long time to come. With high-grade tool steels and special alloys, the case is different. Crucible steel, so-called, is made in small units and the labor cost is high. An equally good grade of steel can be made in the electric furnace in much larger units and the consequent saving more than outweighs the extra cost of electrical heating. In fact, it is not too much to say that the crucible process is doomed. The Heroult furnace is a resistance furnace with two carbon electrodes dipping into the molten slag, beneath which is the fused steel. The Colby furnace (1890) and the Kjellin furnace (1900) are practically identical and are induction furnaces without electrodes. There is a high voltage primary and the metal to be melted is put in a ring-shaped crucible and constitutes the low voltage secondary. These furnaces were small ones at first, holding one ton of metal or at most three tons. Quite recently, however, a twenty-five-ton furnace of this type has been built. The actual data as to their performance are a bit meager, but it seems to take from 600-900 kilowatt hours to make a ton of steel, starting with cold iron.

The electric furnace has been used experimentally to make pig-iron from ores, but it can not compete with the blast furnace as far as any ores are concerned which the blast furnace can handle economically. On the other hand, owing to the higher temperature obtainable, the electric furnace may be able to give good results with ores rich in sulphur or titanium, ores which the blast furnace people can not or will not handle. The electric furnace is already a successful competitor of the blast furnace in the matter of ferro alloys.

Ferrosilicon is made in an arc furnace with an 85-volt arc striking between the walls of the crucible and four movable carbon electrodes, each twelve inches square. As the temperature at which silicon volatilizes is only a little above that at which the reaction takes place, it is impossible to heat the ferrosilicon up to a point at which it can be drawn off continuously. The process is therefore discontinuous, about 1200-1500 pounds of fifty per cent ferrosilicon being obtained at a single pour. This product competes with pure silicon made in the electric furnace and with blast furnace ferrosilicon containing perhaps fifteen per cent silicon. The chief use of ferrosilicon is in deoxidizing iron and it is usually added in the ladle. If a low grade ferrosilicon is used, so much has to be added that there is danger of chilling the melt. Pure silicon is unsatisfactory since it does not mix readily, owing to the difference in the density between it and the metal.

Ferrochrome is made in an arc furnace with the crucible as one electrode and four 8-inch graphite pencils as the other. The voltage used is 110. Since chromium is not volatile, ferrochrome can be heated to a temperature at which it flows freely. The process is therefore a continuous one, a single furnace running, perhaps, six months on a stretch. The product is a ferrochome containing seventy per cent chromium, and it can be sold at the same cost per unit of chromium as the blast furnace ferrochrome, which contains only fourteen per cent chromium. There is one rather interesting point about this ferrochrome. The chrome iron ore, from which it is made, is brought to this country all the way from New Caledonia. A part of the output is then shipped back across the continent again and sent over the Pacific to Japan to be used in making armor plate. The rest is sold in this country and in England for the same purpose.

With the manufacture of phosphorus a new factor comes in. The old method involved the treatment of phosphate rock with sulphuric acid and the subsequent reduction with coke. In this process the sulphuric acid was lost. By working at a higher temperature it is possible to substitute sand for sulphuric acid, and phosphorus is now made by heating phosphate rock, sand and coke in a resistance furnace. The extra cost of electric heating is met by the decrease in the cost of the raw materials.

In the manufacture of carbon bi-sulphide, the cost of electric heating is covered by the increased yield per day, owing to the greater reaction velocity at the higher temperature and by the advantage due to internal heating. Carbon and sulphur are heated together in a furnace forty-one feet high and sixteen feet in diameter. The current used is 4000 amperes at 40-60 volts. The yield is about ten thousand pounds of carbon bi-sulphide a day, and one furnace has been known to run for seventeen months before shutting down. Owing to the internal heating, it is possible to keep all joints tight and to avoid the extreme discomfort usually attendant on the manufacture of carbon bi-sulphide.

These instances serve to illustrate the points in which the electric furnace is superior to other forms of heating. It is not enough that a product can be made in an electric furnace. If the industry is to be on a sound basis, the manufacture by means of the electric furnace must be the cheapest method of production.

KORTING ELECTRIC TEMPERING FURNACE.

Messrs. Korting Bros., of Berlin, have constructed a new type of electric furnace for tempering steel. The metal is placed in a fused salt, which must have a high melting point, and not evaporate to a perceptible degree, even at a high temperature. With barium chloride one can thus maintain a temperature of 1,300 degrees Centigrade. The furnace is in form of a square box, made of asbestos iron and refractory bricks, inside which there is a square space forming the crucible, which is filled with salt. Two iron plates attached to opposite sides act as electrodes for the alternating current supplied by an oil transformer. When the salt is melted the metal object is lowered down, and temperature can be controlled with a pyrometer and rheostat. Differences of temperature are very slight at various points of the molten mass, varying, for example, from 1,108 degrees to 1,123 degrees Centigrade. With this device tools weighing more than 2,200 kilogrammes can be raised to a temperature of 850 degrees Centigrade in four minutes. It is well to heat these tools to bright red before putting them in the furnace. When the latter is kept at its maximum of 1,300 degrees Centigrade for ten hours there is no need to add more than one kilogramme of barium chloride, a substance which seems best for extreme temperatures. For lower ones a mixture of barium chloride and potassium chloride can be utilized. The furnace lining lasts a year. As for the crust of melted salt which adheres to the steel, it falls away of itself when the steel is dipped in cold water.

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EDITORIAL.

San Francisco's Reproach.

San Francisco's cup of bitterness is not yet full. This week another strike was added to the long list to discommode and vex the community. Last Saturday the operators of the Western Union and Postal Telegraph Companies, both in San Francisco and in Oakland, left their keys. Both companies in a measure were prepared for the strike, and have been able to give the public moderate service. The fundamental cause of this latest strike seems to have been the same old one—not so much a question of hours and wages as the determination of the operators to force the companies to recognize the Unions, and to employ none other than Union men. Both companies have accepted the challenge, and here again we are to witness a struggle of employer against employe on the vital principle of the "Open Shop."

Business, of course, has been discommoded seriously; but if reports in the daily press are to be believed, the troubles and vexations that threaten to overwhelm many business men in San Francisco are not yet complete. We are informed that the mail carriers are planning to strike on July 1. With the telephone service still handicapped, with uncertain telegraph wires, with long delayed freight, with disinclination on the part of the bankers to extend credit, and now with the prospect of interruption of mail service, surely the merchant or manufacturer in San Francisco needs the patience of Job and the sanguine temperament of a Joshua.

It is obvious that San Francisco was selected as the theatre of the telegraph operators' strike, because this city is considered the stronghold of Trade Unionism throughout the country, and that here the prospects seemed brightest for victory.

Some there may be—ardent and blind sympathizers with Trade Unionism, right or wrong—who would profess themselves well satisfied that San Francisco should have been so selected. Others—and we hope they are in the majority—will, as does "The Journal," deplore the fact that San Francisco has become notorious, the world over, as the City of Strikes, almost all of which are foolish and needless.

Obviously such a reputation constitutes a grave reproach—a reproach to the common sense of this community, a menace to peace and prosperity, and a distinct injury to the credit of its business men and the financing of its necessary enterprises.

Mr. James D. Phelan returned from a mission to the East last week, and reports that the credit of San Francisco has been severely shaken, not by the disasters of April, 1906, but by the perpetual strikes and dissensions that have since caused even more serious upheaval, and by the fact that abnormal conditions have prevailed, sending prices both of labor and living "sky high," and thereby perverting what once was, and should be, a most fruitful field for investment, into a locality shunned by conservative financiers. Mr. Phelan had the greatest difficulty in placing loans for $4,500,000, loans which under normal conditions could have been negotiated easily, since the securities were undeniable.

Nor is the reproach that San Francisco is a "City of Strikes" limited merely to our commercial prosperity and our financial credit. The finger of scorn from all parts of the earth is pointed at San Francisco because her municipal government is a farce—at present a double-headed hydra—and, moreover, because property is insecure and the safety of the citizen upon her streets is by no means assured.

We have witnessed this week Brigadier-General Funston's refusal to accept the invitation of the Fourth of July committee for the presence of Federal troops in the parade. General Funston was disinclined to run the risk of men wearing Uncle Sam's uniform

being sneered at and jeered at by an "as yet unwhipped mob." He was afraid that the "day we celebrate" might be marred by a breach of the peace precipitated by hoodlums insulting the troops or throwing bricks at them from the tops of buildings.

While we do not agree with General Funston's position, because we do not believe that in any American city American troops would fear anything, especially by their appearance in a Fourth of July parade, and while we fancy that a demonstration by the troops next week might have exercised a wholesome influence upon the lawless elements of this community, yet we must admit that the phrase used by General Funston is well founded and distinctly justifiable.

No man who has walked the streets, or ridden in the street cars, or even read the daily press of this city during the last two months, can deny that there is a large lawless and vengeful element in our midst today. Women have been insulted, innocent men assailed, property destroyed, and mobs have rioted on our streets. There is available on every hand plenty of evidence that there is an "as yet unwhipped mob" in San Francisco.

No citizen can read without shame the accounts of the violent outrage near the Chutes last Saturday evening, when a gang of eight men, three of whom were captured and identified as Union men, stormed a street car and violently assaulted its crew. No true San Franciscan can read without shame and alarm of the two riots by which the peace of the Sabbath was destroyed in the Mission last Sunday. These men should be punished as speedily as possible, and given the maximum sentence under the law. Then, if they should ever again try to mingle with the people of the city they should be drummed out of town—they do not belong in any city or town in America.

Sooner or later the mob must be whipped, or else the reproach of San Francisco will remain. The city has no confidence in its Chief of Police. There are many fine fellows and good citizens in San Francisco's police force, who are able and willing to do their duty, but the demoralization of the police as a whole is complete, due to the thieves and cut-throats who are still in nominal control of the administration of the city. As long as the mob exists the sacred liberty of the individual cannot be assured. The God-given right, guaranteed by the State and Federal constitutions for a man to exercise his own discretion under the law, how and for whom he will work, cannot be protected as long as the San Francisco mob remains unwhipped.

But no matter in what sense General Funston used the words "unwhipped mob," San Francisco will see to it that the proper persons are good and soundly whipped. San Francisco is now in a financial crisis. It will be far worse before it is any better. Honest and dishonest labor will suffer; merchants and bankers will feel the blows which are to come. Every one will seriously feel the effect of the absolutely necessary reconstruction of the city's affairs. And the mob will surely be whipped in more ways than one.

We do not hesitate to tell what seems to us the truth regarding San Francisco's serious situation, but sooner or later, in good and sufficient season, the hoodlum, the grafter, and the thug who brings discredit on all labor, will not only be whipped but will, we believe, be permanently banished from what will some day again be "THE GOOD CITY OF SAN FRANCISCO."

TRADE CATALOGUES.

Bulletin No. 57 from the Bristol Company, Waterbury, Conn., shows Bristol's A. C., D. C. Recording Voltmeter, Type 8, both switchboard and portable forms.

General Electric Company, Schenectady, N. Y., sends a number of well-illustrated bulletins describing various kinds of apparatus manufactured by them. They include the following subjects: Commutating Pole Railway Motors; Lightning Arresters, 1907 Types; Electrically-operated Rachet-Driven Rheostat Switches; Edison Miniature Incandescent Lights; Cast Grid Rheostats; C. Q. Generators and Balancer Sets; Thomson Single-phase High-torque Induction Wattmeter; G. E. Knife-blade Switches, and Parts of R. Controllers. A description of the electrification of the West Jersey and Seashore Railroad is of interest.

PERSONAL.

The local offices of the Electric Storage Battery Company, of Philadelphia, Pa., will be moved from 11 Hawthorne Street, to the Crocker Building, San Francisco, about July 1.

Clarence C. Wilson, M. E., has moved from 507 Market Street to 22 First Street, where he has opened offices as mechanical consulting engineer.

Mr. H. A. Kluegel, of Oroville, has accepted a position as chief engineer for the Truckee Lumber Company, with headquarters at Truckee.

OCEAN SHORE RAILWAY.

Tuesday afternoon a trial trip was made on the Ocean Shore Railway. A construction car, bearing the president of the Company, J. Downey Harvey; Sidney Sprout, engineer; W. G. Vincent, assistant engineer, and other officials and newspaper men, started from Twelfth and Howard Streets to make the run over the two and one-half miles of track. The electrical appliances of the car worked well, and the run from Twelfth and Howard Streets to Twelfth and Division was made smoothly. At Division Street the trolley pole broke and fell on the car and struck Engineer Sprout on the head, inflicting a severe lacerated wound of the scalp.

Starting at 4 o'clock Wednesday, the first complete run over the line was made. The route traveled was from Twelfth and Howard Streets to Division, to Florida, to Mariposa, to Potrero Avenue, to Twenty-fifth Street, to Vermont, to Army, to Kentucky. An inspection of the freight yards site, which extends parallel with Army Street from Vermont to Kentucky, was made. It is expected that the Ocean Shore Road will be in operation from Twelfth and Market Streets, the local terminal, to Point San Pedro, within a few months.

LOCAL STOCKS AND BONDS

Furnished by Courtesy San Francisco Stock and Bond Exchange.

Outstanding	INTEREST	MISCELLANEOUS BONDS.	JUNE 21		JUNE 22		JUNE 24		JUNE 25		JUNE 26		JUNE 27	
			Bid	Asked	Bid	Asked	Bid	Asked	Bid	Asked	Bid	Asked	Bid	Asked
1,532,000	F & A	Associated Oil Co. 5%		81		81		81		81		81		81
2,250,000	M & S	Bay Counties Power Co. 5%		100		100		100		99		99		99
1,000,000	F & A	Cal. Central Gas & El. 5%		103		103		103		103		103		103
9,600,000	M & S	Cal. Gas & El. Gen. M. & C. T. 5%		80	77	79	77	79	77	80	77	80		80
900,000	J & J	California St. Cable Co. 5%	100	103½	100	105		105		105	100	103	102	
2,000,000	J & J	Contra Costa Water Co. 5%	100	102½	100	102½	100	102½	101½	102½	101½	102½	101½	102½
1,000,000	J & J	do do Gen. Mtg. 5%		97½		97½		97½		98		98		98
623,000	F M A N	Edison Light & Power 6%		115		115		115		115		115		115
650,000	M & S	Ferries & Cliff Ho. Ry. 6%	103		103		103		103		103		103	
671,000	A & O	Geary St. Ry. 5%	52		52		52		52		52		52	
610,000	M & N	Honolulu R. T. & L. Co. 6%	105⅜		105¼		105½		105¼		105¼		105¼	
300,000	A & O	Lake Tahoe Ry. & T. Co. 5%												
500,000	J & J	Los Angeles Elec. Co. 5%	100		100		100		100		100		100	
1,300,000	J & J	Los Angeles Gas & Elec. Co. 5%		101½		101½		101½		101½		101½		101½
5,000,000	A & O	Los Angeles Ry. 5%	106	108	106		106		106	107½	106	107¼	106	107
1,000,000	A & O	Los Angeles Lighting Gd. 5%		105		105		105		105		105		105
1,500,000	A & O	Los Angeles Pac. R. R., 1st Con. Mtg. 5%	102½	103½	102	103½	102	103½	102	103½	102	103½	102	103½
3,030,000	M & S	L. A. Pac. R. R. of Cal. 5%		102½		102½		102½		102½		102½		102½
3,000,000	J & J	Market Street Cable 6%	107		107		107		107		107		107	
5,141,000	M & S	do Ry., 1st Cons. Mtg. 5%		103		103		103	100	104	100		100	103
100,000	A & O	Mill Valley & Mt. Tamalpais S.Ry. 5%	103		103		103		103		103		103	
4,751,000	A & O	Northern Ry. Co. of (Cal.) 5%	111	112		112		112		111¼		111¼	110½	
1,498,000	J & J	North Pacific Coast R. R. 5%	100¾		100¾		100¾		100		100		100	
1,074,000	J & D	Northern Cal. Railway 5%		105		105		105		105		105		105
980,000	J & D	Northern Cal. Power Co. 5%		100		100		100		99		99		100
6,000,000	A & O	Northern Electric Co. 5%		97½		97½		97½		97½		97½		97½
1,000,000	M & S	Oakland Gas Light and H. 5%	102	107	102	106	102	107		105		105		105
1,374,000	J & J	Oakland Transit Co. 6%	111		111		111		111		111¼		111¼	
1,600,000	J & J	Oakland Transit 5%	103		102½		102½			104		104		104
1,326,000	J & J	Oakland Transit Con. 5%	101½	102½	101¾	103	101							
7,000,000	J & J	Oakland Traction Con. 5%		101½		101½		100		99		99		99
1,500,000	J & J	Oakland Water Co. gtd. 5%		97½		97½		97½		97½		97½		97½
2,000,000	A & O	Omnibus Cable Ry. 6%	112	118	112	118		118		114		114	110	116
1,149,000	S D M J	Pacific Gas Imp. 4%		95		95		95		92½		92½		92½
8,494,000	J & J	Pacific Electric Ry. Co. 5%	101¾	102¼	101¾	102⅛	102	102¼	102	102¼	102¼		102¼	102½
4,491,000	J & J	Pacific Light & Power Co. 5%		100		100		100		100		100		100
3,000,000	J & J	Pacific Tel. & Tel. Co. 5%		104		104		104		104		104		104
350,000	J & J	Park & Cliff House Ry. 6%												
250,000	J & J	Park & Ocean R. R. 6%		112½		112½		112½		112½		112½		112½
700,000	M & S	Powell Street Railway 6%		107½		107½		107½		107½		107½		107½
2,500,000	M & N	Sacramento Elec. Gas & Ry. 5%		100	98	99	98	99	98	99	98	99		100
6,000,000	A & O	S. F. & S. J. Valley Ry. 5%	111		111		111			112	111		111	
3,000,000	J & J	S. F., Oak. & San Jose Ry. 5%	103½		103½		103½		103½		104		104	
1,500,000	J & J	do do 2d Mtg. 5%		101		101		101		101		101		101
1,500,000	A & O	S. J. & S. Clara Co. R. R. 4½%		91		91		91		91		91		91
642,000	A & O	Sierra Ry. of Cal. 6%	108½		108½		108½			108		107		106
6,000,000	J & J	S. P. R. R. of Arizona 6% (1909)	103½		103½		103½		103½		103½		103½	
4,000,000	J & J	do do do (1910)	104		104		104		104		104		104	
5,116,000	A & O	S. P. R. R. of Cal. 6% (1912)		110		110		110		110		110		110
4,127,500	M & N	S. P. R. R. of. Cal., 1st c. gtd. 5%	113⅝	116⅞	113⅝	116⅞	113⅝	116⅞	113⅝	116⅞	113⅝	116⅞	113⅝	116⅞
3,533,000	A & O	S. P. Branch Ry. of Cal., 6%	123¾		124		125	128	124¾		124¾		124¾	
81,178,000	J & J	S. P. R. R. Co., 1st Ref'd'g. 4%	90	91	90	91	90⅜		90½	91	90½	91	90½	91
17,500,000	J & D	Spring Valley Water Co. Gen. Mtg. 4%		85½		85		86		86	84½	85	84½	85
300,000	M & S	Stockton Gas & Elec. Co. 6%	100		100		100		100		100		100	
2,000,000	J & J	United Gas & Elec. Co. 5%												
20,000,000	A & O	United R. R. of S. F. 4%	69		68⅝		68¾	69½	69	69½	69	69½	69	69½
2,500,000	M & N	Valleys Counties Power Co. 5%		100		100		100		100		100		100
		Water Stocks.												
		Contra Costa		62		62		62		62		62		62
6,000	Quarterly	Marin County		62		62		62		62		62		62
280,000		Spring Valley Water Co.	19⅞	20¼	19¾	20		20	19¾	20	19¾	20	19¾	
		Gas and Electric Stocks.												
37,500		Martel Power Co.												
9,340		Mutual Electric Light Co. (Ctfs.)	4½		4½		4½		4½		4½	4¾	4½	
37,336		do (Extended Ctfs.)	12½	13	12½	13	12½	13	12½	13	12⅝		12⅝	
40,000	Monthly	Pacific Lighting Co.	60	75	60			70		70	57½	70	55	70
12,000		Stockton Gas & Elec. Co.	52		52		52		52		52		52	
		Street Railroad Stocks.												
10,000		California		135		135		135		135		135		135
10,000		Geary		41		41		41		41		41		41
10,000		Presidio		25		25		25		25		25		25
	Semi-an.	Associated Oil Co.	33½	33¾		34	33	33¾	32	33	31⅝		32¼	
1,625	Quarterly	Mill Valley & Mt. Tamalpais S. Ry.		110		110		110		110		110		110
180,000	Quarterly	Pac. Tel. & Tel. Co. (Pfd.)		95		95		95		100		100		100
180,000		Pac. Tel. & Tel. Co. (Common)	7½	15	7½	15	7½	15	7½	15	7½	15	7½	15

Unlisted Securities

Outstanding	Interest	Security	June 21 Bid	June 21 Asked	June 22 Bid	June 22 Asked	June 24 Bid	June 24 Asked	June 25 Bid	June 25 Asked	June 26 Bid	June 26 Asked	June 27 Bid	June 27 Asked
750,000	A & O	Bay Counties Power Co. 6%		103		103		103		103		103		103
745,000	M & S	Blue Lakes Water Co. 6%												
2,000,000	A & O	California Northwestern Ry. 5%		108		108		108		108		108		108
160,000	J A J O	Marin County Water 5%		100		100		100		100		100		100
600,000	J & J	Risdon Iron Works 5%		100		100		100		100		100		100
500,000	M & S	S. F. Dry Dock 5%		109		109		109		109		109		109
8,000,000	M & N	S. F. Gas & Electric 4½%		95		95		95		95		95		95
3,926,000	J & J	S. F. & North Pacific Ry. 5%	103		103		103		103		102¾		103	
5,500,000	J & J	South Pacific Coast Ry. 4%		95		95		95		95		95		95
		Standard Electric Co. 5%		92½		92½		92½		92½		92½		92½
		do do Gtd. 5%		95		95		95	80	85	80	86	80	86
750,000	J & J	Sunset Tel. & Tel. Co. 6%												
2,250,000	A & O	Sunset Tel. & Tel. Co. 5%		105¼		105¼		105¼		105¼		105¼		105¼
1,000,000	M & N	Sutter Street Railway 5%		105		105		105		105		105		105
		Stocks.												
50,000	Monthly	Gas Consumers' Association												
100,000	Monthly	Northern Cal. Power Co.	20¾	21½	20¾	21½	20¾	21½	20¾	21½	21		21	
		Pac. Gas & Elec. (Pfd.)		50		50		50		50		50		50
		Santa Cruz Port. Cement		55	50	51½	50			55		55		50
		Standard Port. Cement (New)		65		65		65		65		65		65
50,000	Monthly	Truckee Electric Co.	15	16	15	16	15		15	16	15	16	14¾	15½

Electrical Construction for the Architect and Engineer

Inspection of Old Wiring.

"The reduction of fire hazards by inspection of new wiring installations is approved practice in all progressive cities, and no arguments are needed to demonstrate the foresight of such work," says the "Western Electrician." "The reliable wiring contractor and the electrician who understands his business have nothing to fear from intelligent inspection by insurance and municipal authorities. The activity of inspectors with reference to new installations, seldom applies in the examination of old wiring, however, for the reason that municipalities are inclined to limit the appropriations for city electrical departments to sums inadequate to provide for the regular examination of either old installations or outside work in addition to the maintenance of fire-alarm and police-telegraph systems, routine office work and the inspection of new wiring layouts.

"A study of the causes of fires as given in the annual reports of chief engineers of fire departments in various cities shows that an exceedingly small percentage of the alarms arise from electrical troubles, but it is none the less important that high standards of wiring shall be insisted upon, because the electrical industry as a whole suffers an injury whenever fires are credited to it, regardless of the justice of the claims, and, of course, because losses can only be reduced by attention to every possible conflagration cause. There is a vital need of inspection of old wiring, for the deterioration of existing installations and the improper connection of apparatus to systems by unauthorized or inexperienced consumers pave the way toward even more serious results than are ordinarily to be expected in the case of new work carelessly installed.

"An illustration of the evils of irresponsible wiring occurred recently in an ice-cream factory operated by electric motors. The original installation was a two-horsepower, 550-volt, direct-current motor, duly inspected and approved, a certificate of operation being given to the local lighting company by the city. A few months later a second motor was installed and connected to the mains. No notice for inspection was sent; neither the city nor the electric-light company had knowledge of the installation of the second motor, and so no inspection was made. The motor was mounted on a revolving iron post and was improperly installed, the floor all around the motor being constantly covered with water. Repeated movements of the revolving post caused the breakage of one of the motor leads, the broken end of the wire coming in contact with the casing of the motor and grounding the current through the wet floor, iron post and motor casing. A workman who investigated the cause of stoppage was killed by the shock, and another employee was seriously injured. The inspection of the installation by the proper authorities and the execution of construction work by qualified employees or contractors in such cases would do much to improve the conditions.

"H. S. K."

APPROVED ELECTRICAL DEVICES.

This department from time to time will contain an illustrated description of all fittings approved by the Underwriters' National Electric Association.

FLEXIBLE CORD, PORTABLE.

For Electric Heaters. Double conductor cord, twisted or flat, composed of stranded, braided conductors, with rubber and asbestos coverings protected by woven cotton braids. Fireproof or weatherproof saturation of outer braids. Approved May 20, 1907. Manufactured by

John A. Roebling's Sons Co., Trenton, N. J.

CABINETS.

"Krantz" panelboard cabinets of wood, metal-lined, or of steel with or without lined gutters. Approved June 8, 1907. Manufactured by

H. Krantz Manufacturing Co., Brooklyn, N. Y.

CONDUIT BOXES.

"Wirelets." For exposed conduit work. All procelain cover types. Approved June 8, 1907. Manufactured by

Appleton Electric Company, Chicago, Ill.

RECEPTACLES, MINIATURE.

G. E. Candelabra, Cat. No. 9446, cleat type, porcelain base, ½-A. 125-V. Approved June 8, 1907. Manufactured by

The General Electric Co., Schenectady, N. Y.

RECEPTACLES, STANDARD.

Chase-Shawmut stage pocket and plug, 50-A, 125-V. Attachment plug for stage cable. An iron floor box in which is mounted a slate base carrying receptacle for special plug. Approved June 8, 1907. Manufactured by

Chase-Shawmut Company, Newburyport, Mass.

G. E. weatherproof rosette receptacle, cleat type. Cat. No. 40,499. Approved for outdoor use only June 8, 1907. Manufactured by

General Electric Co., Schenectady, N. Y.

ROSETTES, ENCLOSED FUSE.

"Thomas" 2-A., 250-V., for use with glass tube enclosed fuse. Cleat type, Cat. No. 3423; concealed type, No. 3424; and moulding type, No. 3425. Approved June 8, 1907. Manufactured by

Perkins Electric Switch Manufacturing Co., Bridgeport, Conn.

ROSETTES, FUSELESS.

Bryant "K. P." cleat, concealed and moulding types. Cat. Nos. 1499, 1710 and 1497. "Junior" cleat types, Nos. 1999 and 297, concealed No. 298 and moulding, No. 299. Approved June 8, 1907. Manufactured by

The Bryant Electric Co., Bridgeport, Conn.

"Knowles" cleat and concealed types, and small cleat type, 3-A, 200-V. Approved June 8, 1907. Manufactured by

C. S. Knowles, Boston, Mass.

P. & S. 3-A, 250-V. Cleat type, Cat. Nos. 602, 603, 607, 703, and 06, with porcelain sub-base, concealed type, No. 604, and ceiling buttons 70 and 170. Approved June 8, 1907. Manufactured by

Pass & Seymour, Solway, N. Y.

SWITCHES, COMBINATION CUT-OUT.

"Paiste." Porcelain base plug cut-outs, with base recessed for D. P. surface snap switches. 10-A, 125 or 250-V. Cat. Nos. 5190, 5193, inclusive. Approved June 8, 1907. Manufactured by

H. T. Paiste & Co., Philadelphia, Pa.

SWITCHES, PUSH-BUTTON FLASH.

"Knowles" single and double-pole and 3-way, 3-A., 250-V., 6-A., 125-V. Approved June 8, 1907. Manufactured by

C. S. Knowles, Boston, Mass.

Perkins S. P. 3-point, 4-point. Cat. Nos. 2201, 2203, 2204, and lock types, 2295, 2296, and 2297. D. P. 10-A., 250-V., Cat. No. 2202, and lock type 2298. Approved June 8, 1907. Manufactured by

Perkins Electric Switch Manufacturing Co., Bridgeport, Conn.

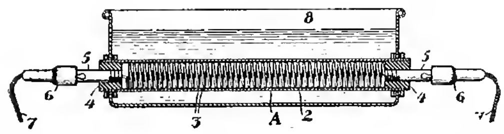
PATENTS.

Electric, Gas and Water.

Specially reported for the Journal of Electricity, Power and Gas.

ELECTRICAL HEATER AND EXPANSION COIL.

No. 856,736. An electrical heater consisting of an exterior tube, an elastic insulating sheet expanded to fit closely within the tube, an electrical resistant coil expanded to fit the interior of the insulating sheet and retain it in close

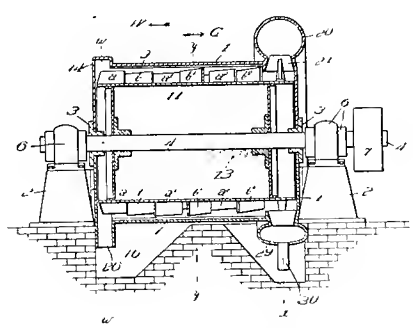


contact with the tube, and connections whereby an electrical current may be passed through the coil, connections including non-conducting bushings fixed in the end of the tube, and plugs fixed in the bushings and connecting with the coil.

Milton H. Shoenberg, San Francisco, Cal., Assignor to Consolidated Electric Appliance Companies.

GAS-WASHER.

No. 856,731. In a gas washer, the combination with a suitable casing having a gas outlet at its rear end, a water inlet adjacent to its rear end, a gas inlet and water outlet in the lower portion of its circumference at its front end, of a water seal arranged below water outlet and forming

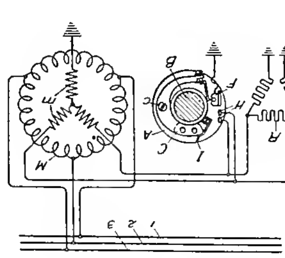


the bottom thereof to receive the water and impurities from the washer, a suitable drum, inclined wings on the drum arranged to force the water centrifugally and forwardly, means to rotate the drum, and means to force the gas through the casing around the drum from front to rear.

Gustav Saaler, New York.

CENTRIFUGAL SWITCH FOR ELECTRIC MOTORS.

No. 856,433. In a motor, a centrifugally-actuated switch carried by the motor armature comprising a centrifugally-movable member, a switch contact operated by member, a

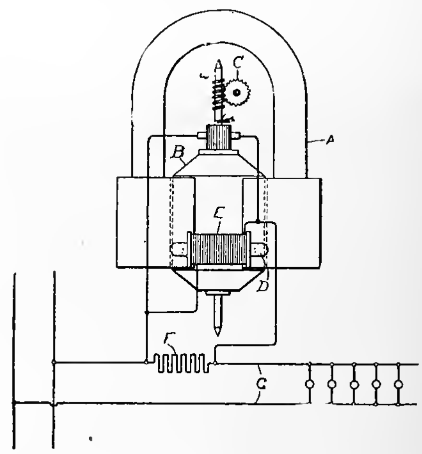


connection between contact and member adapted to move contact in a substantially circumferential direction when member is moved centrifugally and to permit a centrifugal movement of contact relative to member; a slide adapted to be traversed by contact when moved circumferentially and to restrain it against centrifugal force, and a switch contact connected to the armature winding of the motor and forming a portion of slide.

Knut Tornberg, Lynn, Mass., Assignor to General Electric Company.

ELECTRIC METER.

No. 856,412. An electric meter comprising a field of substantially constant strength on full load, a rotatable armature, connections for supplying to armature a voltage

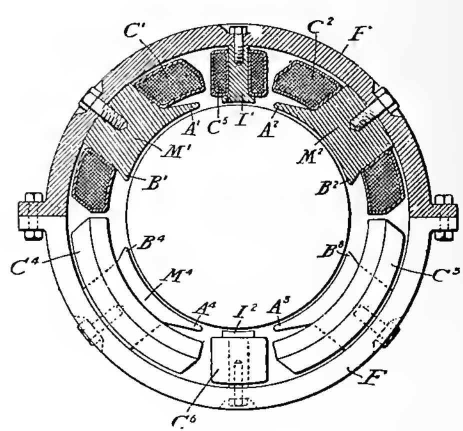


proportional to the load-current, a registering train driven by armature, and means for producing a decrease in the strength of field on light load.

Arthur J. Martin, Rugby, England, Assignor to General Electric Company.

ALTERNATING CURRENT MOTOR.

No. 856,477. In an alternating current motor, the combination with a primary member having a winding adapted to produce a plurality of numbers of magnetic poles and means for changing from one number to another, of a sec-



ondary member having a plurality of windings of different resistance that are respectively effective for different numbers of poles in the primary member.

Benjamin G. Lamme, Pittsburg, Pa., Assignor to Westinghouse Electric & Manufacturing Company.

INDUSTRIAL

ELECTRIC LABOR-SAVING DEVICES IN THE HOUSEHOLD.

It is not only possible for the resident of a large city or town to have the advantages of electric labor-saving devices in the home, but it is also possible, by means of the great improvements in gasoline engines, and the introduction of alcohol as a fuel for internal-combustion engines, to provide electric current in the country home, for lighting and other service to which it is so well adapted.

It is now generally acknowledged that the modern home is not complete unless it is wired throughout for electric current, for there are no labor-saving devices of greater importance at the present time than those now available for operation by electricity in the home.

ELECTRIC BREAKFAST-COOKING SET

A newly-constructed house can hardly be said to be up-to-date which is not wired for electric light, with convenient receptacles for heating devices, electric cooking apparatus, fan motors and other motors to be used on the electric lighting circuit.

The electric light vitiates the atmosphere less than any other form of light, and produces very little heat to make the reading room and lounging room of the country home or city residence disagreeable during the hot summer months.

The electric ventilation by fan motors is most perfect, and the conveniences which electricity affords are many and various. An up-to-date electrically-operated house near Schenectady includes the electric cigar lighter and electric radiator for use on chilly evenings. The electric equipment of the dining room includes electric chafing dish and coffee percolator, electric water boiler with cereal cooker and vegetable steamer attached. There are also to be found the electric frying pan and other standard cooking and baking outfits. The electric breakfast set is unique in construction, and the general electric cooking and baking table is equipped with electric broilers and other devices, including a five-combination electric cooking apparatus. In the laundry are electric flat-irons, electric wash boilers, and immersion heaters, which lighten the labors of the servants.

The electric dish-washing machine and the electric meat and vegetable chopper, as well as the potato-peeling machine shown in the accompanying illustration, indicate some of the modern conveniences now available for the home provided with cheap electric current. In the kitchen an electric fan not only keeps the room free from smoke and disagreeable odors, but also is utilized for drying pots and kettles, while the electric oven, pancake griddle and broilers make the duties of the cook less difficult to perform, while the electric chafing dish and teapot in the dining room or sitting room make the entertainment and refreshment of the caller a most pleasant duty for the housewife.

The kitchen and pantry of the large country home which is provided with cheap electric current can utilize to advantage the electric knife sharpener, the electric coffee grinder, and electric vegetable cutter for slicing beets, turnips and cabbages, while in the bath room electric water heaters may be utilized, as well as the massage motor and the electric shaving cup.

In the sewing room a small electric motor operates the sewing machine, and an electric sad-iron is provided for pressing the finished garments.

In the bed-chamber electric outlets are provided for the electric curling iron and the baby milk warmer, while throughout the entire home electric lights are well arranged, and electric heating devices, including electric radiators of the luminous type, may be employed for Winter and Fall use, and the electric fan for keeping the rooms cool in Summer.

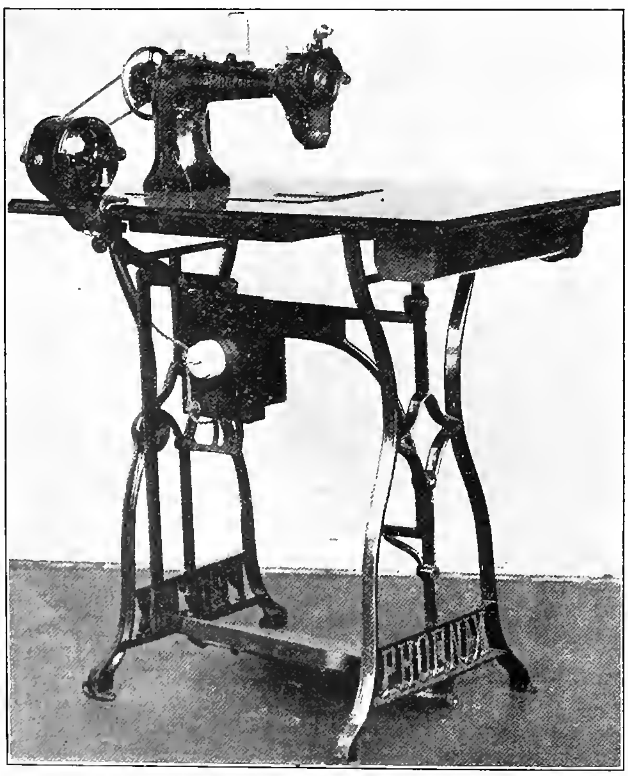
A unique French system has been developed for heating, known as the electric thermophile in which Oriental Gobelin, Moquette carpets and rugs have electric heating wires woven in them, the same method of weaving insulated wires in electrically-heated coverlets and quilts being devised.

It is well known that electricity, the transmitting agent of power and light, is also an excellent producer of heat. By causing a certain density of current to pass through a conductor of determined resistance, the energy contained in the electric current can be almost completely transformed into heat. It will be noted that this action is of immediate effect from the beginning to the end and produces no smoke; con-

sequently there are no gaseous products.

It will be noted that the heating furnished by the electric thermophile realizes a considerable progress over all systems of heating heretofore used. Such heating can be obtained wherever the electric current is already used for lighting and that by means of carpets, coverings, coverlets and lace fabrics which by their suppleness, elegance and comfort are adapted to all the exigencies of the most luxurious modern residence.

FAN FOR DRYING DISHES



SEWING MACHINE RUN BY MOTOR

In the house it is the least cumbersome, as a supple wire, an electric coupling with suitable switches and fusible plug are sufficient to convey with security, the current to the thermophile.

In the bedroom it is the cleanest method of heating; in fact, it creates neither dust nor odor and requires neither reservoir nor fuel. The carpet which is a necessary element in the most simple furnishings and harmonizes with the business office as also with the elegance of the most luxurious saloon.

In the dining room or parlor it is least dangerous; it presents no danger of fire or of accident when the fitting, which is very simple, is undertaken by a competent person, it cannot give a greater heat than that for which it has been arranged, provided that when in use it is completely spread out in the free air, and is working at the tension arranged.

As to the cost of operation it is most economic if it is duly considered that it affords the best heat over large surfaces, and that it instantaneously transforms into heat all the electricity it receives, as soon as it is placed in circuit.

PRIZES FOR AN ELECTRICAL SOLICITOR'S HANDBOOK.

The following extract from a paper by Mr. R. S. Hale, of Boston, on "The Value and Use of a Solicitor's Handbook," will be of interest to those who are already competing for the prizes, as well as to others who may now contemplate to do so.

The paper above referred to was presented on the Commercial Program of the National Electric Light Association at Washington, on June 7th, 1907.

> "I want now to make a brief announcement of a change in plans in connection with the prize contest for the best electrical solicitor's handbook. The Co-operative Electrical Development Association wrote to all of those who had manifested an interest in the proposed contest last April to find out how they felt about an extension of time in which to submit the competing books.
>
> "By general agreement the time was set for October 1st, next, and all of the competitors must have their work turned in to the Co-operative Electrical Development Association, Cleveland, Ohio, by that time.
>
> "I am sure you all appreciate the value of this contest to central stations and others, because of the stimulating of interest everywhere and a fixing of the minds of a great many agents upon the details of their own handbooks through a desire to think up some way by which they could get into this contest.
>
> "I hold in my hands a New York draft for \$2,600.00 which represents the total amount to be awarded in prizes to the successful competitors in this handbook contest. The money will be placed in a bank, where it will draw interest until the time the awards are made in October, so that the winners will not only get their prize money, but interest on it as well."

Those interested in this subject will be furnished promptly a pamphlet giving full details and particulars, upon application to the Co-operative Electrical Development Association, Cleveland, Ohio.

NEWS NOTES

TRANSPORTATION.

San Francisco, Cal.—President J. Downey Harvey, of the Ocean Shore Railroad, has appointed E. T. Charlton traffic manager for the company. Rapid progress is being made in the section of the new electric line in this city, and on the section between San Francisco and Half Moon Bay. When completed to Santa Cruz the road will be eighty-eight miles in length. A branch line to Watsonville is also planned. At Watsonville the proposed San Joaquin Western line is connected with it.

Fresno, Cal.—W. G. Kerchoff, who represents the Huntington Electric interests through the State, and is himself heavily interested in several schemes, declares that the money stringency occasioned by this attitude of the President is hindering the financing of the Yosemite road. The surveys have all been completed, and Engineer Newman expects to have the plans and estimates ready in a very little while, but the financing, says Kerchoff, has been interfered with by the conditions of finances stirred up by Roosevelt. No new lines, except those already announced, will be built in the near future.

Sacramento, Cal.—That the Northern Electric is a railway in the general sense of the term, and not an intercounty street car system, is in effect the decision of the State Board of Equalization, which, on the advice of the Attorney-General, concluded that the assessment of the tracks and rolling stock of the new electric line comes within the State jurisdiction. That part of the assessment work which the ruling of the Supreme Court does not allot to the State Board, such as assessment of sidings, depots, etc., will be made by the several County Assessors through which the lines of the company run. A like decision was made regarding the Vallejo, Benicia and Napa Electric.

Lodi, Cal.—Samuel B. McLenegan, formerly of the Huntington system in Los Angeles, but who resigned to become General Manager of the Central California Traction Company, declares that the company would be held back for some time from running their cars to this city by the failure of the insulators for the third rail to arrive. All other necessary material is on hand. The road from Stockton to Lodi will only be the beginning of a big system which will be built up by the traction company if given the proper support. The wires for the new company's line have been strung through this city, and only awaited the track being built from Stockton to be connected with what was already laid here. It was hoped that the line would be in operation by July 1st, but, owing to the failure of the insulators to arrive, the opening of the system has been unavoidably postponed.

Sacramento, Cal.—At their last meeting the Judiciary Committee of the Board of the City Trustees had a session with a representative of the Northern Electrical and the Vallejo Northern Railroads, at which the project of granting these roads franchises through the city, were thorougly discussed. The Northern Electric people desire a freight franchise from Eighteenth and C to Thirty-first, to R, to Second to M, to the river. The Vallejo road desires to obtain entrance through the city at a point near the foot of P Street, and the representatives of both roads were deadly in earnest in their demands. They pointed out that as far as they were concerned they had nothing to do with a bridge over the river, but they felt that they had no right to grant even an approach to the river until the representative of the United States Government had decided where such a structure should be located.

San Francisco, Cal.—President Stetson says: "We are going to establish open shop on the California Street line. We have had some men in our employ for a long time, and we would prefer to have them run the cars for us again; but we deal with them individually only. If they are not willing to come back on that basis we will have to fill their places. We cannot afford to pay more than the old rate, which was established by arbitration at 30, 31 and 32 cents. We should have started the line sooner if it had not been necessary to do certain repair work, but as soon as this is completed we will begin immediately. We will have nothing further to do with the Carmen's Union. The men individually are good men, and we should prefer to have them in our employ again; but we will not deal with them as an organization. I want that to be made perfectly plain. Some of our men have promised to return, and, as a matter of fact, most of them would like to go to work again. We will have no trouble in getting all the men we need."

ENGINERING.

Montesano, Wash.—United States Government Engineers have begun the survey of the Chehalis River from this place to Aberdeen, in accordance with an act passed by the last session of Congress.

Riverside, Wash.—During the past week three irrigation pumping plants have been installed along the Okanogan River, one for J. Foss Sargent, near Tonasket; one for James Carpenter, at Riverside, and one for McPherson Bros., at Brewster. This week there will also be one put in for C. S. Lee, at Omak.

Portland, Ore.—Colonel S. W. Roessler, in charge of the local office of the United States Engineers, opened bids for the delivery of rock at the Columbia River jetty, and recommended the awarding of contracts to the Columbia Contract Company. The bids were for two deliveries, one of 200,000 tons of small rock and one for a million tons of larger material. The former was for $1.10 and the latter for $1.12. Specifications call for delivery at the dock at Fort Stevens. Besides the bids submitted by the Columbia Contract Company, only one other was received. It was from the Puget Sound Bridge and Dredging Company, at $1.30 per ton for both classes of waterial.

ELECTRIC RAILWAYS.

Seattle, Wash.— Wightman & Muckler, to whom was granted a franchise for the Shore Line Electric Railway Company, have complied with all requirements of the Council, and work on the big project will begin on or before July 1.

Vancouver, Wash.—The Washington Railway & Power Company has been granted a franchise to build and operate a street railway system in Vancouver. One mile of track is down. In two months it is expected that the system will be in running order.

Colfax, Wash.—The Pullman, LaCrosse & Columbia River Railroad, a proposed electric line from Pullman to the Columbia River, which is being promoted by J. O. Staats, Dr. H. M. Greene and E. S. Knowlton, of La Crosse, is the latest railroad project in Whitman County.

Montesano, Wash.—The Grays Harbor & Puget Sound Railway announces that it has been decided to follow the original survey approved by Chief Engineer Clapp, and to build the main line up the south bank of the Chehalis River, crossing at Montesano, and then go east to Elma and the Sound.

New Westminster, B. C.—The latest application comes from the new electric railway company known as the Burrard, Westminster & Boundary Railway & Navigation Company. This company plans to build to Seattle from this city. The solicitor appearing on behalf of the company is Sir Charles Hibbert Tupper.

George W. Gregory, a Seattle attorney, who recently appeared before the Council asking for a franchise for an electric railway here, as well as for electric light and water franchises, was present at the meeting and announced to the Council that if it considered Weeks' proposition was preferable to his they should accept it.

Chehalis, Wash.—B. J. Weeks, of Tacoma, has asked the City Council of Chehalis for a 50-year franchise for the Centralia-Chehalis Electric Railway & Power Company. It is proposed to build an interurban electric line between Chehalis and Centralia. Weeks gives the assurance that actual construction will begin within sixty days, and that he now has a mile of steel which is available for this line, with six miles more that he can divert here.

LIGHT AND POWER.

Snohomish, Wash. — The Council ordered a new 10-inch wooden water main to be laid immediately, at a cost of $630. A 10-year contract with the Snohomish Electric Light & Power Company to furnish power for the pumping station at two and one-half cents per kilowatt hour, a minimum charge per month of $100, was approved and entered into. This will go into effect as soon as the new 6-inch auxiliary pump arrives. It is estimated this will save the city close to $100 per month.

TELEPHONES.

Kalama, Wash.—The Home Tel. Co. of Woodland has completed its line to Looney's Camp, and is putting in wire to Spelei.

New Westminster, B. C.—The Burnaby & Coquitlam Tel. Co. has been granted permission to enter the city to make connection with the city sustem.

Ellensburg, Wash.—The Park Tel. Co. has petitioned the County Commissioners of Kittitas County for a franchise for a telephone line along certain county roads.

New Westminster, B. C.—The Farmers' Tel. Co. will be ready to do business in Delta in about a month. The central office of the company will be located at Ladner.

Everett, Wash.—The Farmers' Mutual Tel. Co. has executed a mortgage in favor of the Title Trust Co. for $1,000,000, the funds so obtained to be used for extensions and improvements.

Colton, Wash.—A new rural telephone company, to be known as the Johnson-Chambers Tel. Co., has been organized at Johnson. President, C. S. Crocker; secretary and treasurer, James C. Langley.

Tacoma, Wash.—The Tacoma Tug & Barge Company is contemplating the equipment of the tug "Fearless" with a wireless telegraph outfit and erecting a station on top of the Pacific Cold Storage Company's building, in which the company has offices.

Seattle, Wash.—The Seattle-Alaska Wireless Telegraph Company has been incorporated by J. E. Chilburg, David Lynch, Jesse A. Frye and Daniel Landon, of Seattle, and Ormsby McHarg, of Jamestown, N. D. Capital, $400,000, for the purpose of installing a wireless telegraph system between Seattle and Nome.

TRANSMISSION.

Pass & Seymour, Inc., of Solway, New York, has taken over the business of the Sarco Company, 906 Sixth Avenue, New York, and will manufacture their electrical specialties, consisting of attachment plugs, pendant switches, key-arm switches, push-buttons, etc.

The Cutler-Hammer Manufacturing Company, of Milwaukee, makers of electric motor controlling devices, has purchased The Wirt Electric Company, and will continue the manufacture of Wirt apparatus. Pending the incorporation in the Cutler-Hammer catalogue of apparatus of the Wirt type, the current Wirt catalogue should be used. Attention is called to the complete line of battery-charging rheostats developed by The Wirt Company, and to the Wirt field rheostats, which in 1902 were awarded the John Scott medal, on recommendation of the Franklin Institute of Pennsylvania. Bulletins covering these and other lines of Wirt apparatus will be furnished on application.

The directors of the Suez Canal Company decided at their meeting of April 8 to authorize passage of petroleum ships through the canal carrying oil in bulk. Hitherto only refined oil was admitted, which was a considerable inconvenience to European nations, or at least some which could, like Russia, command the market of the East; or, like England and Holland, profit by the rich deposits of the Sunda Islands The new regulations are given, in extenso, by the "Echo des Mines" of May 30.

FINANCIAL.

It is announced that the Compania de Tranvias, Luz y Fuerza of Guadalajara will build a transmission line from Guadalajara to Aguascalientes, a distance of about 125 miles. It will dispose of about 5000 horsepower in that city. The company has a capital stock of $11,000,000. Andres Bermejillo of Mexico City has been elected president of the company.

Inland Empire System.—At the annual meeting in the Terminal Building, Spokane, June 15, the directors and officers of the company were re-elected as follows: F. A. Blockwell, Chairman of the Board; Jay. P. Graves, President; F. Lewis Clark, First Vice-President; A. L. White, Second Vice-President; W. G. Davidson, Secretary; H. B. Ferris, Treasurer; Aaron Kuhn, W. G. Graves and Waldo G. Paine.

Pasco Electric Line.—Gustave Harras, of Walla Walla, has made application for a franchise to operate a street railway system at Pasco, Wash., south of Spokane. The council has asked for a statement under which the system would operate and wants a time limit to be set for the completion of a specified distance of the line, which will probably be that two miles of the system must be completed in two years. The franchise will probably be presented and granted before this year draws to a close.

Colville and Metaline.—S. H. Anschell, of Metaline, is back of a project to unite Colville and Metaline, mining towns, by a railway, forty miles. A committee has been appointed to confer with officials of the Great Northern and Jay P. Graves, president of the Spokane & Inland Empire system. The committee is composed of John B. Slater, B. H. Hammond, Sig. Dilsheimer, Hugh Waddell, W. C. Winter, A. E. Veatch, F. H. McDermott, and John D. Millspaugh. If the companies do not take up the project the people of Stevens County, Washington, will build the line, Metaline pledging itself for one-third of the capital required.

Wallace and Coeur d'Alene.—Charles Sweeny, president of the Exchange National Bank, and the Federal Mining and Smelting Company, of which he is the head, are reported to be financing the projected electric railway between Wallace and Coeur d'Alene, Idaho. The survey is through Fourth of July Canyon, in which survey was made by the Federal Mining and Smelting Company some time ago, but it was not satisfactory and H. F. Robertson, formerly locating engineer for the Inland Empire system, has been employed to secure a more satisfactory route. It is believed the purpose of the company in building the railroad is to establish a smelter near Spokane, in which event the line will be extended to that city.

Big Bend Transit.—William Nicholls, a director of the company, announces that construction work from Spokane to the junction of the Spokane and Columbia rivers will begin in a short time, eighty-five per cent of the right-of-way to Davenport, fifty-seven miles, having been secured. It is purposed to extend the line to Rickey Falls, sixty-five miles. Seven miles of the roadbed has been graded. H. W. Wallace, of Chicago, who recently made a trip over the routes, said: "There is practically unlimited power in the falls at the site secured. It is near the junction of the Spokane and the Columbia and it is perfectly adapted for such use. The river runs through a deep gorge, thirty-five feet wide at the present water line, and widening upward to about fifty feet.

Columbia and Walla Walla Traction.—J. H. Morrow, general manager, announces that he has just received the report of H. U. Wallace, of Chicago, an engineer who was sent to Walla Walla recently to make an examination of the territory through which the proposed road is to run, take a note of the physical conditions of the country on either side of the line for six miles to determine the probable freight and passenger traffic tributary to the line for the Wallace-Coats Company of Chicago. The report, which is favorable, takes in the territory originally considered between Dayton, Columbia County, and Wallula, via Milton and Freewater, also the proposed extensions on either end from Wallula to Pasco, to make connection with the principal trunk lines, and from Dayton to Lewiston, as well as the proposed connection with the Inland Empire system from Spokane at Pennewawa, on the Snake River, between Colfax and Dayton.

Spokane, Pend d'Oreille Rapid Transit.—J. J. Browne of Spokane, one of the organizers and shareholders in the company, has bought for $35,000 a terminal site on Squaw Bay, Idaho, for the line, and announces that work will be pushed on the road, forty-two miles. Construction work has been delayed by suits in the Idaho courts, but now that F. A. Blackwell has allowed the statutory time limitation in which to file notice of appeal from the judgment of Judge W. W. Wood to expire, the litigation may be regarded as ended. J. Grier Long, treasurer of the company, added: "We are to build out of Spokane from Washington Street through Pacific Avenue, which is now being paved. This will increase the expense of building about $12,000 in the part that is being paved, since the pavement must be torn up. The abutting property owners will also suffer loss, for now they must pay for the paving which the railway company would have done in the first instance but for the delay. The road will run through a country which is building up rapidly and will furnish much traffic."

Spokane.—Nine members of the Seattle branch of the Independent Institute of Electrical Engineers visited Spokane June 15 and 16 and inspected the plants of the Washington Water Power Company and the Spokane and Inland Empire Electric Railway, where on the last-named the single-phase system of transmission is employed. The visitors were piloted by J. B. Fisken and W. F. Zimmerman. H. R. Stevens, consulting engineer for the A. S. Downey Company of Seattle said at the close of the trip: "This territory has taken the lead in the matter of electric lines and transmission, being far ahead of the Coast cities in the extensiveness of its electric lines and equipment. The single-phase system of operating electric lines, as used by the Inland Empire lines, has, we believe, been shown to be a complete success." The party was composed of C. E. Magnusson, professor of electrical engineering in the University of Washington; W. S. Wheeler, franchise inspector for the city of Seattle and secretary of the Seattle branch of the national organization of electrical engineers; G. W. Pielver, general manager for the Allis-Chalmers Company at Seattle; A. C. Babcon, general manager for the General Electric Company at Seattle; C. Remschell, electric salesman for the Allis-Chalmers Company; A. L. Snyder and C. A. Sears, for the Seattle Electric Company; Fred G. Simpson, of the Kilborn-Clarke Company, and H. R. Stevens, consulting engineer for the A. S. Downey Company of Seattle. Professor Magnusson was elected delegate to the national convention at Niagara Falls.

FINANCIAL.

San Francisco.—The Metropolitan Light and Power Company, successors to the San Francisco Coke and Gas Company, has given a mortgage to the Knickerbocker Trust Company on all its properties to secure a bond issue of 5 per cent forty year bonds to the amount of $7,500,000. A former bond issue of $2,500,000 is to be retired, and with the $5,000,000 remaining the company purposes an extensive development of its plant.

Alameda.—At a meeting of the City Council last week a resolution was adopted instructing the City Attorney to begin an action against the Oakland Traction Company for the purpose of forfeiting the company's franchise on Park street, from Santa Clara Avenue to Harrison Avenue, about a half a mile of the road. This demand for forfeiture is based on the charge by the city that the company is not acting in good faith. The company will resist the efforts of the city authorities to invalidate the franchise.

Redding.—J. A. Whitehead, President of the Pacific Power Company, D. D. Egilbert, former Secretary of the company, and L. A. Bauter, who has served a brief term as Secretary subsequent to Egilbert's recent resignation, have been cited to appear before Judge Bush in the Superior Court and show cause why they should not be punished for contempt, in connection with the writ of mandate issued by the Court on May 23d, commanding W. D. Egilbert, as Secretary of the company, to exhibit the corporation's books to T. W. H. Shanahan, a stockholder, who had been denied access to them. The Court placed the order in the hands of the Sheriff and W. D. Egilbert and L. A. Bauter were served with the notice, but Whitehead could not be found.

Bakersfield.—The assessment of the Standard Oil Company's pipe line will be placed at $2,750 a mile. That was determined at a meeting of Assessors of the counties through which the pipe line runs, held in Visalia. These counties are: Alameda, Contra Costa, San Joaquin, Stanislaus, Merced, Fresno, Kings, Tulare and Kern. Assessors from all these counties were represented at the Visalia meeting, either in person or by letter. At a previous meeting it was decided to raise the assessment from $2,000 a mile to $3,000. The Standard protested against this increase of a third, claiming that the line had deteriorated by the action of the alkali on the pipe. Representative Morrow, of the company, had been to see the various Assessors. Various Assessors agreed to lower the assessment if others would, and the result was the calling of the meeting. The Standard tried hard to get the assessment reduced to $2,250, but this was opposed vigorously by some of the Assessors, and finally $2,750 was agreed upon as a fair figure.

San Francisco.—The Supervisors have voted to give the Spring Valley Water Company such aid as will enable it to go ahead with its projects for insuring additional fire protection. This promise was given in response to a communication from the Merchants' Association calling on the Board to incorporate in the budget an appropriation of $239,000 to the Spring Valley Company to insure these improvements. The proposition was to vote $180,000 for the use of water hydrants, $20,000 in public buildings, $10,000 for the streets, $15,000 for the schools and $14,000 for the parks. The suggested amendment to the budget was not made, but Mr. Gallagher, speaking from the Chair for the Board, said: "The Board, during the year to come, will make such appropriation as will give the Spring Valley no excuse for not bringing in sufficient water for fire and other purposes. While the budget should be finally passed now without further amendment, I am confident that the Board will find money in the surplus funds for the Spring Valley."

San Francisco—Affidavits and comparative tables covering two hundred typewritten pages have been prepared by City Attorney Burke and his Chief Assistant, Wm. T. Baggett, in answer to the application of the Spring Valley Water Co. for an injunction restraining the city from putting into effect the ordinance fixing water rates for the fiscal year, which is to begin July 1st. It is the contention of the water company that the ordinance would reduce its earnings to such an extent that under the changed conditions, due to the earthquake and fire, it would not be able to pay even its fixed charges, such as operating expenses, taxes and the interest bonded indebtedness. In the answer, which is to be filed to-day, in behalf of the city, stress is laid on a comparison of the ordinance at issue and the ordinance of 1902, under which the water company has been collecting rates for five years. A summary of what the city says on this point has been compiled in the City Attorney's office. It is contended that the company can afford to accept the proposed rate ordinance.

INCORPORATIONS.

The C. C. Harris Oil Company has been incorporated with a capital stock of $1,000,000 by C. C. Harris, E. E. Cates, N. L. Bryant, W. A. Martin and A. M. Gates.

Fresno.—The Mountain Girl Oil Company has been incorporated with a capital stock of $350,000, by T. G. Hart, F. M. Helm, Jacob Clark, J. A. McClurg, Jr. and A. W. Anderson.

San Luis Obispo.—The Nipomo Oil Company has been incorporated with a capital stock of $500,000, shares $1 each. Directors: Frank Dana, W. A. Bumgartner, Hans Melschau and others.

Sonora.—The La Grange Water and Power Company has been incorporated with a capital stock of $100,000, shares $100 each. Directors: J. P. O'Brien, E. P. Epperson and E. W. Billeb.

Los Angeles.—The Imperial Water Company, No. 10, has been incorporated with a capital stock of $500,000, subscribed, $50. by R. C. Powers, Wm. Farr, Thos. O'Brien, G. M. Purcell and T. J. Turner.

Napa.—The Calistoga Water Company has been incorporated with a capital stock of $75,000, shares $100 each, subscribed $300, by E. L. Armstrong, C. M. Hover and Raymond Benjamin, 1 share each.

Fresno.—The Kern Trading and Oil Company has been incorporated with a capital stock of $1,000,000, subscribed in full, by Julius Kruttschnitt, $998,000, J. H. Wallace and W. A. Worthington of San Francisco, J. L. Wilcutt of Oakland and J. E. Foulds of Berkeley, $500 each.

The Compania Hidro-Electrica San Agustin, which was recently organized at Puebla, Mexico, with a capital stock of $1,000,000, will install a hydro-electric plant and furnish the city of Puebla with light and power. Fernando Pimentel y Fagoaga is president of the company.

ILLUMINATION.

Oroville, Cal.—The maximum rate which the local electric light company will hereafter charge for lights, where meters are used, is eight cents per watt. This is a reduction of four cents on the present rate, and is the result of the Board of Trustees elected to cut the rates keeping their ante-election promises.

Santa Rosa, Cal.—Chief Engineer E. C. Jones, of the gas department of the Santa Rosa Lighting Company, stated that work would begin in the near future on the construction of the additional holder. It will be 100,000 cubic feet capacity, and the framework is being manufactured at the present time.

San Francisco, Cal.—The San Francisco Gas and Electric Company has submitted to the Board of Supervisors bids for lighting the public streets and outlying districts at the rate of 8.7 cents a lamp each night for gas and 20 and 713-1,000 cents for electric arc lamps per night. The bid for lighting public buildings is 60 cents for each 1,000 cubic feet for gas, and 4 cents per kilowatt for electric current. The bids, which are the only ones filed, have been referred to the Light Committee.

Portland, Ore.—The Economy Gas Company, which has secured a franchise from the city by vote of the City Council, has refused to admit the company to the use of the streets or pipes in competition with the Portland Gas Company. The company is controlled by E. E. Lytle and R. W. Colson, who hold eighty per cent of the stock. They will begin laying pipes, in a short time, in the streets, and expect to be attacked by the Portland Gas Company, in the courts, in a suit to enjoin their company from using the streets. The Portland Gas Company holds a franchise granted by the Territorial Legislature of Oregon, January 7, 1859, authorizing Henry D. Green and his successors to establish a gas manufactory in the City of Portland, Multnomah County, Territory of Oregon, conveying to Green and his successors "the sole right and use to lay and extend throughout the said City of Portland," for an indefinite period. The new franchise provides that work shall begin within six months from the date of acceptance of the franchise by the company, "unless delayed by judicial action or causes not the fault of the grantee." The cost is to be approximately $1,500,000. The company is required to spend $5,000 a year for maintenance of the plant. The company is not to charge more than ninety-five cents per 1,000 feet for gas, but the company expects to charge seventy-five and eighty-five cents. The duration of the franchise is to be twenty-five years. One per cent of the gross earnings is to be paid to the city. The new company is to give $5,cco bond to the city for performance terms of the contract, and after three years is to be delivered of the bond, if by that time it has spent $250,000.

TELEPHONE AND TELEGRAPH.

Red Bluff, Cal.—Supervisors—An application has been made by Attorney Wells for a franchise for a pole line on which to string a telephone wire between Red Bluff and Tom Head Mountain. The franchise is for the California & Massachusetts Copper Mines Company.

Coalinga, Cal.—J. N. Wheeler has asked what steps the city demands should be taken in securing a franchise for an independent telephone company which desired to do business in Coalinga. He was informed a petition in the form of an ordinance would be necessary to grant the franchise, and is having the petition prepared and will present it at a later meeting.

OIL.

The Section 6 Oil Company, just northwest of the Alladin, has now struck sand at 2,040 feet. The sand from this well looks unusually rich and from all indications the well when completed will prove a great producer.

The Shreeve well, located west of the Alladin Oil Company, will soon be in producing condition. This well showed unusual gas pressure while being drilled, and but for a mishap in casting off the water would be equal to the Lucile as a producer.

The St. Francis Oil Company have their rig completed and are placing the machinery in position preparatory to starting work immediately on their land, located on Section 6, southwest from the Alladin. The Lucile gusher still maintains its great flow, and although almost a year old both gas pressure and production of oil is much better now than it has been since the well was brought in.

Bakersfield.—According to the latest news from the Coalinga oil fields the greatest activity prevails at present in the West side in the territory on and surrounding the north half of Section 6, on the outskirts of the town of Coalinga. In the very heart of this district is located the Alladin Oil Company, just adjoining the famous gusher of the Lucile Oil Company. The only thing which prevents the beginning of much new work is scarcity of material, such as lumber, casing, etc. Prominent oil operators from all portions of the State are visiting this district, and property in the proven belt is rapidly being bought up. The Associated Oil Company, on Section 36, adjoining the north half of Section 6, has four standard strings and one rotary well drilling and is now erecting a new steel tank of 35,000 barrel capacity and a pumping station.

WATER WORKS.

Redwood—Plans for a new water system here for adequate protection against fire have been taken under consideration by the Town Trustees. At the last meeting of the Trustees a communication was received from the Board of Trade to the effect that that organization would aid in the work to safeguard property. It is believed that a site will be purchased in the foot hills and a reservoir constructed or a stand pipe system installed. At present the water pressure is low and impractical in fighting fire.

Redding—The Northern California Power Company has begun the erection of a boiler shop building on the site of Smith's lumber yard, on South Street. In this shop will be made all the steel pipe the company will need at its Battle Creek power plant. The shop will become a permanent fixture in Redding, and aside from doing work for the power company will do custom work for all comers. It will probably give employment to fifteen or twenty men.

C. H. Hollingsworth, Superintendent for the Great Western Power Company, at Island Bar, has resigned his position to go with his family to his home in the East. His successor is B. S. Roberts, who has resigned from the Southern Pacific to take the place. Mr. Roberts is a well-known engineer. He recently completed the Bay Shore cut-off near San Francisco for the Southern Pacific. W. H. Bissell, formerly purchasing agent for the Great Western Power Company, has been promoted to the position of Assistant Superintendent.

POWER AND LIGHT PLANTS.

Chewelah, Wash.—The city will erect a water and light plant to cost $14,000, and be completed by October 1st.

Lewiston, Ida.—Preliminary work on construction of a big power plant for the Lewiston & Southeastern Railway has commenced.

Marysville, Cal.—The California Midland Co. has advertised for bids for the grading on the main line of their road to Grass Valley and Nevada City. As soon as the bids are in, and the contract let, work will be rushed on this branch. The company expects to have their line completed to Hammonton City, Cal., the first of October, a distance of eleven miles. Eight miles is on the main line to the above mentioned towns, while three miles will be taken up by a spur into Hammonton. The rails will be laid two-thirds of this distance along the south levee of the Yuba River.

The first annual convention of the Illuminating Engineering Society will be held at Boston, Mass., Tuesday and Wednesday, July 30 and 31, 1907. The program as to hours and number of sessions will be announced later, but from the material already in the hands of the various committees and the promise of many additional valuable papers and exhibits, there can be no question of the assured success of the convention and its educational value to each and every member.

TELEPHONE AND TELEGRAPH.

San Francisco, Cal.—The Pacific Tel. & Tel. Co. offer a $500 reward for the arrest and conviction of any person or persons cutting or injuring the overhead or underground cables or wires of the company. The strike of the linemen against the telephone company is practically ended. The linemen either will return to work before midnight next Tuesday or their places will be filled by members of the International Brotherhood of Electrical Workers.

TRANSMISSION.

Willows.—Charles H. Glenn, one of the promoters of the Snow Mountain Power Company, says that all of the first issue of the stock had been sold. This stock was disposed of mostly in Colusa County. Work has been commenced on the large plant, and by next November power will be furnished for various counties. Mr. Glenn says that he expects to see an electric line running up Bear Valley in the near future, and also prophesies that the line will be extended to the Fouts Springs. At the last session of the Board of Supervisors Richard Bane of San Francisco, who is acting as attorney for the power company, made application for a franchise to run a line throughout the country for the purpose of furnishing power at various points. There is also a rumor to the effect that the Willows Water and Light Company will consolidate with the Snow Mountain Company.

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ELECTRIC RAILWAYS.

Pasco, Wash.—Gus Harras has made application through his attorney, J. W. Brooks, of this city, for an electric railway franchise through the streets of Pasco, where Mr. Harras has extensive property interests.

Rosalia, Wash.—Work of extending the Spokane & Inland Electric Railway, which has been practically suspended since February, was actively resumed this week and construction crews have been transferred from the east to the west branch. It is probable that the laying of steel to Colfax will be completed by August 1, and regular service installed by October 1.

Lewiston, Ida.—A. P. Cahill, of Dayton, Wash., one of the directors of the Columbia & Walla Walla Traction Co., which is financing the building of an electric line from Wallula, Wash., to Lewiston, states that the company has the right-of-way for the line secured from Wallula to Dayton, and that work on this part of the road will begin this year. The matter of securing the right-of-way from Dayton to Lewiston will be taken up as soon as possible.

Everett, Wash.—A deal involving more than $1,000,000 and the construction of an electric railway system from Tacoma to Vancouver, passing en route through Bellingham, was closed this week, when Stone & Webster purchased all the holdings and franchises of the Everett Electric Company. This transfer, carrying with it about twenty-four miles of road, fine power houses and valuable suburban franchises, insures the long-talked-of Tacoma-Vancouver line, and will serve to make Bellingham one of the greatest trading centers in the Northwest.

GAS.

The Lodi Gas Company, of which Mr. Henry Keyes, of Sacramento, is general manager, expects to have their plant completed by October the first. The expenditure involved in this construction is put at $70,000.

Endeavors are being made in Germany to produce a new kind of steel improved by a certain percentage of metallic calcium, which, it is said, gives some very desirable qualities to the product. Certain metallurgists have long expected this new steel, and the actual experiments are being made to confirm or finally disprove this theory. Processes to extract metallic calcium from certain ores, in sufficient quantity and at a cost suitable for industrial purposes, have been invented at the Bitterfeld Electrotechnical Works (Prussian Saxony). A series of experiments are now being made with calcium thus prepared by the works in question and several firms manufacturing steel in Westphalia and the Rhine district. According to the German Press, results do not seem to have been satisfactory. A report was published in "Metallurgie," based upon the extensive studies and experiments made by an eminent specialist. "By these experiments," it says, "it is demonstrated that metallic calcium does not combine with iron in the molten form. Consequently its employment for iron alloys is impracticable."

ELECTRIC LIGHTING.

E. B. Hillman has asked the town of Sidney, Iowa, for a franchise for an electric lighting plant.

The Home Light, Water and Ice Company of Blooming Grove, Tex., has been capitalized at $30,000.

The San Francisco Gas and Electric Company has ordered a 5000-kilowatt, 3-phase generating unit for its main power station in the Potrero district. It consists of a Curtis steam turbine and a General Electric 11,000-volt generator. It is understood that one of the present 1500-kilowatt units will be removed from the station and rebuilt for use in the Pacific Gas and Electric Company's new 3000-horsepower steam relay plant at Petaluma. An additional 500-horsepower exciter will be installed in the Potrero station, making the net gain in generating capacity by the changes about 3000 kilowatts.

A mortgage deed of trust for $7,500,000 from the Baltimore Electric Company to the Northern Trust Company of Philadelphia has been filed. It conveys all the land and property, including plants and all equipment, franchises and all the income and profits of the Baltimore concern to the Philadelphia corporation in trust. The deed also includes the bonds of the Maryland Telephone and Telegraph Company. This transaction completes the plan of consolidation and capitalization of the Baltimore Electric Company, which recently was formed by the merging of the Baltimore Electric Power Company and the Maryland Telephone and Telegraph Company.

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